

SECTIONS OF THE ROSE HILL AND
McKENZIE FORMATIONS OF THE
SILURIAN OF MARYLAND

BY
WM. F. PROUTY

[Extract from]
A Dissertation submitted to the Board of University Studies of
The Johns Hopkins University in conformity with
the requirements for the degree of
Doctor of Philosophy

June, 1906



BALTIMORE
THE JOHNS HOPKINS PRESS
1923

*Diss. Baltimore
1906*

SECTIONS OF THE ROSE HILL AND
McKENZIE FORMATIONS



Digitized by the Internet Archive
in 2026

https://archive.org/details/IA41546428_0027

SECTIONS OF THE ROSE HILL AND McKENZIE FORMATIONS

BY

W. F. PROUTY AND C. K. SWARTZ¹

A. Sections in the Wills Mountain Anticline

I. Section at Pinto

The finest section of the McKenzie formation and of the upper part of the Clinton in Maryland is seen at Pinto, a station on the Baltimore and Ohio Railroad, 8 miles southwest of Cumberland. The Potomac River flows across the western limb of the Wills Mountain anticline cutting the strata, which stand nearly vertical. The natural section has been rendered still more perfect by the construction of the railroad so that an uninterrupted section is exhibited extending from the base of the Helderberg to the upper part of the Clinton, embracing the entire Tonoloway, Wills Creek, and McKenzie formations.²

The McKenzie and about 150 feet of the Rose Hill formation are seen in the cut west of the cement mill formerly operated at this place. The middle beds of the Rose Hill, which are much folded and largely concealed, lie in the hillside back of the mill. The Cresaptown iron sandstone and a portion of the immediately adjacent strata are exhibited in the slightly dipping and more or less folded eastern limb of the anticline, a short distance east of the mill. The Roberts iron ore is represented by a mere trace at the top of the Keefer sandstone, although it is a foot and a half

¹ The sections west of the Fairview anticline were described by the senior author, who also identified the non-ostracod species, the junior author cooperating in the study of critical points in the field. The sections in the Fairview Mountain anticline were described by the senior author. The ostracods named in the sections were identified by Ulrich and Bassler.

² The formation receives its name from McKenzie station which is situated at the eastern end of the railroad cut.

thick just across the river in West Virginia. The *Whitfieldella marylandica* zone is found at the top of the Rochester formation, while the *Uncinulus obtusiplicatus* zone is 39 feet below the top of the McKenzie.

As a collecting ground the section is much inferior to those exposed at Cedar Cliff, Rose Hill, and Cumberland, due, in part, to the less weathered condition of the rocks at Pinto. It is, however, unequaled for its completeness.

Plate V shows the McKenzie formation exposed here with its nearly vertical strata. The beds are intricately folded and much faulted, making an accurate measurement of their thickness rather difficult. The throw of each fault has been calculated as accurately as possible and the measurements given are very nearly correct.

The section described below embraces the McKenzie, Rochester, and a large part of the Rose Hill formations. It begins at the base of the Bloomsburg member of the Wills Creek formation, in the cut west of the cement mill, and extends to the eastern end of the cut, east of the mill.¹

WILLS CREEK FORMATION

Bloomsburg Member

	Horizontal distance from top of Keefer sandstone to top of beds		Thickness			
			Beds		Total	
	Feet	Inches	Feet	Inches	Feet	Inches
Yellow, disintegrated limestone, <i>Cedar Cliff</i> limestone	376	0	..	..	..	..
Massive, greenish-gray sandstone.....	..	..	8	6	8	6

MCKENZIE FORMATION

Greenish-gray and brownish-yellow, thin-bedded sandstone transitional to Bloomsburg sandstone containing <i>Clidophorus nitidus</i>	367	6	2	6	241	6
Drab shale containing many indistinct worm borings	365	0	14	6	239	0
Dark arenaceous limestone and drab shale, limestone predominating. Fault at bottom	350	6	8	0	224	6

¹ The horizontal measurement begins at the top of the Keefer sandstone and extends along the railroad track. This section is continuous with the section of the Wills Creek and Tonoloway formations described on pages 114-126.

	Horizontal distance from top of Keefer sandstone to top of beds		Thickness			
			Beds		Total	
	Feet	Inches	Feet	Inches	Feet	Inches
Drab shale and interbedded impure dark limestone, mostly shale. The lower beds contain <i>Lingula</i> sp., <i>Camarotæchia andrewsi</i> , <i>Uncinulus obtusiplicatus</i> , <i>Homæospira evax</i> var. <i>marylandica</i> , <i>Uncinulus obtusiplicatus</i> zone. A thrust fault in this unit has 1-foot throw.....	342	6	25	0	216	6
Interbedded drab shale and dark impure limestone containing various species of <i>Euklædenella</i> and <i>Dizygopleura</i>	322	0	4	0	191	6
Interbedded drab shale and dark impure limestone in about equal amounts, carrying <i>Tentaculites niagarensis</i>	313	0	8	0	187	6
Interbedded drab shale and some dark, impure limestone in beds from 1 to 3 inches, containing <i>Camarotæchia andrewsi</i> , <i>Clidophorus nitidus</i> . Ten feet below the top occurs <i>Buthotrephis gracilis</i> var. <i>intermedia</i> , <i>Whitfieldella marylandica</i> . <i>Otenodonta subreniformis</i> is found at base....	..	..	23	0	179	6
Dark, calcareous shale bearing <i>Lingula</i> sp., <i>Homæospira evax</i> var. <i>marylandica</i> , <i>Clidophorus nitidus</i> , <i>Pterinea flintstonensis</i> , and <i>Hormatoma marylandica</i>	273	0	7	6	156	6
Drab shale and occasional limestone layers bearing <i>Clidophorus nitidus</i> , <i>Pterinea flintstonensis</i> , <i>Hormatoma marylandica</i> .	264	0	14	6	149	0
Thick-bedded, dark impure limestone.....	..	..	1	6	134	6
Drab shale and some thin-bedded, dark, impure limestone bearing at top <i>Clidophorus nitidus</i> and <i>Hormatoma marylandica</i>	248	0	3	0	133	0
Thin-bedded, dark, impure limestone and some interbedded drab shale bearing <i>Lingula gracilis</i> and <i>Hormatoma marylandica</i>	..	..	5	0	130	0
Thin-bedded, dark, impure limestone and drab shale in about equal amounts. About 9 feet from top is a small fault with a heave of approximately 8 inches. This unit contains <i>Buthotrephis gracilis</i> var., <i>Lingula gracilis</i> , <i>Dalmanella ele-</i>						

	Horizontal distance from top of Keefer sandstone to top of beds		Thickness			
			Beds		Total	
	Feet	Inches	Feet	Inches	Feet	Inches
<i>gantula</i> , <i>Camarotoechia andrewsi</i> , <i>Clidophorus nitidus</i> , <i>Hormatoma marylandica</i> , <i>H. hopkinsi</i> , <i>Homæospira evax</i> var. <i>marylandica</i> , <i>Pterinea flintstonensis</i>	..	..	44	0	125	0
Dull-black to drab shaly limestone resembling a cement rock. Fault at top of unit. The bottom of this unit was situated at the west end of spring before the fill was made. (West end of spring is at 173 feet of traverse).....	182	0	6	0	81	0
Interbedded, dark, impure limestone and shale containing <i>Hormatoma marylandica</i> and <i>H. hopkinsi</i>	172	0	27	0	75	0
Interbedded shale and dark, impure limestone carrying in upper part <i>Clidophorus nitidus</i>	..	..	20	0	48	0
Concealed along railroad track by faulting.	117	0	5	0	28	0
Drab shale and interbedded dark limestone. Four feet above its base in center of a small anticline (72 feet west of top of Keefer sandstone) is a dark limestone interbedded with gray limestone which contains <i>Reticularia bicostata</i> and <i>Clidophorus nitidus</i>	117	0	8	6	23	0
Thick beds of limestone and interbedded shale. Three feet above base occurs numerous <i>Beyrichia moodyi</i>	..	..	5	0	14	6
Massive dark impure limestone and some interbedded shale. The limestone bears <i>Reticularia bicostata</i> , <i>R. bicostata</i> var. <i>marylandica</i> , <i>Beyrichia moodyi</i> , <i>Dizygo-pleura micula</i> , <i>Euklædenella longata</i> , and other species of <i>Euklædenella</i>	..	..	5	6	9	6
Drab shale with some bands of dark limestone. This unit is badly crushed. Thickness estimated	62	0	1	6	4	0
Thick-bedded, dark limestone containing numerous elongated limestone pebbles of a different color. This bed forms a projecting ledge near top of cut.....	..	..	2	6	2	6
Total thickness of McKenzie formation					241	6

ROCHESTER FORMATION

	Horizontal distance from top of Keefer sandstone to top of beds		Thickness			
			Beds		Total	
	Feet	Inches	Feet	Inches	Feet	Inches
Dark shale	54	0	1	3	39	0
Thick-bedded, dark, lenticular limestone and some interbedded dark shale. The limestone contains <i>Whitfieldella mary-</i> <i>landica</i> , <i>Lingula</i> sp., <i>Dizygopleura pricei</i> , <i>D. gibba</i> , <i>D. intermedia</i> var. <i>antecedens</i> , <i>D. intermedia</i> var. <i>cornuta</i> . Thickness along track	..	..	4	6	37	9
Thick-bedded, dark lenticular limestone with some interbedded shale. <i>Whitfield-</i> <i>ella marylandica</i> is very profuse 3 feet above base. <i>Tentaculites niagarensis</i> oc- curs near base. The base of this unit is repeated 43 feet west of the top of the Keefer sandstone by minor faulting. Thickness about	..	..	4	6	33	3
Dark-gray shale with thin beds of crystal- line bluish-gray limestone. <i>Cornulites</i> <i>rosehillensis</i> and <i>Schuchertella elegans</i> occur about 18 feet above its base. <i>Dal-</i> <i>manites limulurus</i> is found abundantly in lower 10 feet of unit. This unit bears <i>Echmina abnormalis</i> , <i>A. postica</i> , <i>A.</i> <i>spinosa</i> , <i>Beyrichia veronica</i> , <i>Dizygopleura</i> <i>symmetrica</i> , <i>Drepanellina clarki</i> abun- dant	29	0	19	0	28	9
Olive shale and bands of highly fossilifer- ous crystalline gray limestone containing <i>Stropheodonta corrugata</i> , <i>Homalonotus</i> <i>delphinocephalus</i> , <i>Drepanellina clarki</i> , <i>Echmina spinosa</i>	..	..	2	6	9	9
Iron ore (<i>Roberts iron ore</i>)	..	..	0	6	7	3

Keefer Sandstone Member

Hard, gray, fine-grained slightly calcareous sandstone	..	..	7	0	7	0
Total thickness of Rochester forma- tion					39	0

ROSE HILL FORMATION

	Horizontal distance from top of Keefer sandstone to top of beds		Thickness			
			Beds		Total	
	Feet	Inches	Feet	Inches	Feet	Inches
Greenish-gray and chocolate-colored shales and interbedded thin bands of sandstone. The shale is more deeply chocolate-colored about 44 feet from the bottom. In the upper 12 feet the sandstone is replaced in part by limestone bands. Toward the top occur <i>Cornulites rosehilensis</i> , <i>Stropheodonta</i> sp., <i>Schuchertella tenuis</i> , <i>Dalmanella elegantula</i> . Fourteen feet below the top of this unit occur <i>Chonetes novascoticus</i> , <i>Echmina crassa</i> , <i>Plethobolbina typicalis</i> , <i>Mastigobolbina arguta</i> . Twenty feet below top occur <i>Chonetes novascoticus</i> and <i>Camarotoechia neglecta</i> . Base of this unit is 115 feet east of top of Keefer sandstone.....	..	..	100	0	552	2
Hackly, chocolate-colored shales showing spheroidal weathering. A few thin sandstone layers occur in upper part of the unit. Towards the bottom the sandstone beds are more numerous and the shales are lighter-colored. Base of this unit is in center of an anticline 190 feet east of the top of the Keefer sandstone. The section is repeated east of this unit.....	..	..	48	0	452	2
Concealed in rear of cement mill. Thickness estimated to be about.....	..	..	150	0	404	2
The section is continued east of the cement mill. Olive to gray shale with a few thin sandstone lenses	..	..	16	0	254	2
Sandstone with <i>Calospira hemispherica</i> , <i>Calymene cresapensis</i> , and many ostracods	..	..	0	6	238	2
Gray, somewhat mottled shale containing many <i>Buthotrephis gracilis</i> var. <i>intermedia</i>	..	..	11	6	237	5
Sandstone layer with many <i>Tentaculites</i> sp., <i>Calymene</i> sp., ostracods and crinoid stems	..	..	0	4	226	2
Gray shale	..	..	3	0	225	10

	Horizontal distance from top of Keefer sandstone to top of beds		Thickness			
			Beds		Total	
	Feet	Inches	Feet	Inches	Feet	Inches
Sandstone with a great many <i>Tentaculites</i> <i>minutus</i>	..	..	0	4	222	10
Gray shale with a few interbedded thin sandstone layers	..	..	20	0	222	6
Gray shale bearing <i>Calospira hemispherica</i> and <i>Buthotrephis gracilis</i> var., <i>inter-</i> <i>media</i> which is more abundant toward the bottom of unit.....	..	..	9	0	212	6
Hackly gray shale with very few sandstone lenses	..	..	8	0	193	6
Red ferruginous sandstone and interbedded shales. The sandstone contains so much hematite as to approach a low-grade iron ore, the <i>Cresaptown iron sandstone</i> , con- sisting of the following beds:.....	..	..	30	6	185	6
Ferruginous sandstone	..	..	0	8	..	..
Gray sandstone	..	..	0	6	..	..
Shale	..	..	0	8	..	..
Interbedded ferruginous sandstone and shale	..	..	1	6	..	..
Massive ferruginous sandstone.....	..	..	4	0	..	..
Shaly sandstone and thin beds of ferru- ginous sandstone	..	..	1	2	..	..
Ferruginous sandstone showing cross- bedding and clay balls at top.....	..	..	0	6	..	..
Ferruginous sandstone, many clay balls and lenses	..	..	1	6	..	..
Interbedded shale and ferruginous sandstone	..	..	1	0	..	..
Ferruginous sandstone, the upper part highly oölitic, the lower part bearing some plant remains. Its upper sur- face is ripple-marked, the wave crests being about 1 foot apart with smaller intervening crests. The troughs be- tween the crests are not quite filled with shale	..	..	1	0	..	..
Massive beds of ferruginous sandstone.	..	..	2	0	..	..
Shale and ferruginous sandstone.....	..	..	1	2	..	..
Massive bed of ferruginous sandstone containing <i>Stropheodonta</i> sp., <i>Meris-</i> <i>tina</i> sp., <i>Orthoceras bassleri</i>	..	..	6	0	..	..

	Horizontal distance from top of Keefer sandstone to top of beds		Thickness			
			Beds		Total	
	Feet	Inches	Feet	Inches	Feet	Inches
Shale and thin ferruginous sandstone.	..	..	0	9	..	..
Ferruginous sandstone	..	..	1	8	..	..
Gray shale	..	..	0	8	..	..
Gray shaly sandstone.....	..	..	0	6	..	..
Fissile gray shale	..	..	1	6	..	..
Ferruginous sandstone	..	..	1	8	..	..
Shale	..	..	0	2	..	..
Ferruginous sandstone in two beds....	..	..	1	3	..	..
Shale	..	..	0	3	..	..
Ferruginous sandstone	..	..	0	5	..	..
Fissile gray shale with a few thin beds of sandstone	..	..	150	0	155	0
Concealed to base of the formation, estimated to be about.....	..	..	140	0	140	0
Approximate thickness of the Rose Hill formation					552	0

Ostracods are very numerous in the McKenzie formation at Pinto and collections taken from nearly every part show most of the following species: *Klædenella nitida*, *Dizygopleura halli*, *D. intermedia*, *D. perrugosa*, *Beyrichia moodyi*.

II. Section along Baltimore and Ohio Railroad, 1½ miles northeast of Pinto

This section embraces 209 feet of the middle and lower strata of the Rose Hill formation and supplements that seen at Pinto. The section here described represents two exposures; one giving the portion of the Rose Hill formation between the Tuscarora and the Cresaptown iron sandstone, the other beginning at the base of the Cresaptown sandstone and extending upwards in the strata.

The first of these exposures is seen where the Baltimore and Ohio Railroad cuts through the eastern of two sharp anticlinal folds which are found between Pinto and Brady, its base being the top of the Tuscarora sandstone. The second begins a little to the northwest of the second sharp fold and continues with low-dipping strata, here and there concealed in part, nearly to Brady station.

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Concealed.				
Shales and interstratified, grayish to brown sandstones with gentle dip, finely exposed along the railroad. The color and character of the shales of some beds seem to change considerably with small difference in location and exposure. Shales barren. The sandstones carry <i>Camarotachia neglecta</i> , <i>Tentaculites minutus</i> , and <i>Calymene</i> sp.	25±	0	209	6
Red ferruginous sandstone and interbedded shale. <i>The Cresaptown iron sandstone</i> comprising the following beds:				
Red fossiliferous sandstone, massive at bottom.				
Shale partings toward top.	13	0	184	6
Greenish-gray, calcareous shale.	6	0	171	6
Red ferruginous sandstone.	4	6	165	6
Olive to greenish-gray, arenaceous shales with sandstone bands which become harder and more numerous toward the bottom. Sparingly fossiliferous. Rather poorly exposed. This unit bears <i>Camaratachia neglecta</i> , <i>Cælospira hemispherica</i> , <i>Tentaculites minutus</i> , <i>Mastigobolbina lata</i>	161	0	161	0
Total thickness of Rose Hill formation exposed.			209	6

TUSCARORA FORMATION

Massive white sandstone.

III. Section at Cedar Cliff

An excellent section of the upper 170 feet of the McKenzie formation is seen in the cut of the Baltimore and Ohio Railroad at Cedar Cliff, Maryland, 4 miles southwest of Cumberland. The strata exposed at this place are almost identical in character with the corresponding beds at Pinto. They are, however, more weathered and the fossils are much more easily obtained.

In the eastern end of the cut a reversed fault, having a vertical displacement of about 20 feet, intersects the rocks lying near the McKenzie-Wills Creek contact. Forty feet below the top of the McKenzie formation occurs a great abundance of *Uncinulus obtusiplicatus*, a species characteristic of this portion of the formation throughout the greater part of

the Maryland area. Below this is a zone abounding in *Camarotoechia andrewsi*. The section here measured is as follows:

WILLS CREEK FORMATION	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
<i>Bloomsburg Member</i>				
Dark-brown sandstone	2	0	22	6
Calcareous shale	1	6	20	6
<i>Cedar Cliff limestone</i> consisting of				
Thin-bedded limestone and shale	1	6	19	0
Rather massive, dark-gray limestone	5	0	17	6
Yellow, disintegrated, ferruginous, thin-bedded limestone and shale. <i>Leperditia</i> sp.	1	6	12	6
Platy, ferruginous and calcareous sandstone. <i>Leperditia</i> sp.	1	0	11	0
Yellowish, sandy limestone, toward base many nodules of limy matter	2	6	10	0
Brown sandstone	2	6	7	6
Argillaceous sandstone with shale partings	5	0	5	0
Thickness of Bloomsburg member			22	6

MCKENZIE FORMATION

Dark, mottled, arenaceous shale	11	0	295	0
Argillaceous sandstone with fucoid markings	1	0	284	0
Dark-gray shale with some interbedded sandstone in the upper part containing, 6 inches below the base, <i>Clidophorus nitidus</i> , <i>Hormatoma</i> sp., and <i>Orthoceras mackenzicum</i>	2	0	283	0
Interbedded shale and thin-bedded limestone bearing, 3 feet 8 inches above the base, <i>Ctenodonta subreniformis</i> common	11	8	281	0
Dark, fossiliferous shale containing <i>Spirifer mackenzicus</i> and <i>Clidophorus nitidus</i> , both common	2	4	269	4
Interbedded shale and thin-bedded limestone	6	4	267	0
Calcareous shale with thin bands of limestone. In the upper 3 feet are found <i>Dalmanella elegantula</i> , <i>Camarotoechia andrewsi</i> , <i>Uncinulus obtusiplicatus</i> , <i>Cuneamya ulrichi</i> , and <i>Poleumita mackenzica</i>	6	2	260	8
Interbedded limestone and calcareous shale. Thicker beds of limestone at the top and bottom of this unit. In the upper 2 feet are found <i>Lingula clarki</i> , <i>Uncinulus obtusiplicatus</i> , and <i>Poleumita mackenzica</i> . From 4 to 6 feet below the top occur <i>Lingula clarki</i> . <i>Dalmanella elegantula</i> in great abundance, <i>Camarotoechia andrewsi</i> in great abundance, <i>Uncinulus obtusiplicatus</i> in great profusion, and <i>Cuneamya ulrichi</i> . From 7 to 12 feet below the top are found				

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
<i>Dalmanella elegantula</i> , <i>Uncinulus obtusiplicatus</i> , <i>Cuneamya ulrichi</i> , <i>Clidophorus nitidus</i> , <i>Hormatoma marylandica</i> , <i>Pleumita mackenzica</i> , <i>Diaphorostoma niagarense</i> , and <i>Tentaculites niagarensis</i> common. In basal limestone occur <i>Bollia immersa</i> , <i>B. nitidula</i> , <i>Zygobeyrichia incipiens</i> , <i>Z. ventricornis</i> , <i>Klædenia normalis</i> , <i>Bythocypris pergracilis</i>	18	6	254	6
Calcareous shale with some thin bands of limestone. <i>Favosites marylandicus</i> common, <i>Dalmanella elegantula</i> , and <i>Tentaculites niagarensis</i> var. <i>cumberlandiæ</i> common occur at 1, 3 and 6 feet below the top, respectively	10	0	236	0
Grayish-green shale and interbedded limestone. From 2 to 6 feet below the top occur <i>Orbiculoidea clarki</i> abundant, <i>Camarotæchia andrewsi</i> , <i>Homæospira evax</i> var. <i>marylandica</i> abundant, and <i>Pterinea flintstonensis</i> . From 9 to 13 feet <i>Pterinea flintstonensis</i> is abundant. Sixteen feet below the top are found <i>Favosites marylandicus</i> , <i>Camarotæchia andrewsi</i> , and <i>Orthoceras mackenzicum</i> . <i>Clidophorus nitidus</i> is common from 17 to 23 feet below the top of this unit. Twenty-five feet below the top it becomes abundant. <i>Lingula subtruncata</i> occurs 26 feet below the top, while 28 to 32 feet below the top are found <i>Camarotæchia andrewsi</i> , <i>Clidophorus nitidus</i> common, and <i>Hormatoma hopkinsi</i> . Thirty-six feet below the top occurs <i>Hormatoma marylandica</i>	42	0	226	0
Dark-blue limestone with thin shale partings. Four feet below the top occur <i>Hormatoma hopkinsi</i> abundant, and <i>Orthoceras mackenzicum</i> . <i>Clidophorus nitidus</i> is found from 5 to 8 feet below the top. Nine to 10 feet below the top occur <i>Hormatoma hopkinsi</i> common, <i>Clidophorus nitidus</i> in abundance and <i>Pterinea flintstonensis</i> . From 14 to 16 feet below the top are found <i>Favosites niagarensis</i> , <i>Orbiculoidea clarki</i> , <i>Homæospira evax</i> var. <i>marylandica</i> common, and <i>Clidophorus nitidus</i> . Twenty-four feet below the top occur <i>Orbiculoidea clarki</i> and <i>Orthoceras mackenzicum</i> . Twenty-nine feet below the top occur <i>Orbiculoidea clarki</i> , <i>Dalmanella elegantula</i> , numerous <i>Homæospira evax</i> var. <i>marylandica</i> and <i>Clidophorus nitidus</i>	54	0	184	0
Concealed. Thickness about.....	130	0	130	0
Total thickness of McKenzie formation about..			295	0

IV. Section at Rose Hill South of Cumberland

An excellent section of the lower part of the McKenzie formation, the Rochester formation, and the upper beds of the Rose Hill formation is seen in the cut of the Baltimore and Ohio Railroad at the southern end of Rose Hill, $1\frac{3}{4}$ miles southwest of Cumberland.¹ This is one of the finest localities in the state for the examination of the Rochester formation and its contact with the immediately adjoining strata and affords an excellent collecting ground for the fossils found in them. It is complicated by faulting, rendering precise measurement of its thickness difficult. A fault seen 46 feet east of the top of the Keefer sandstone causes the lower 20 feet of the overlying beds to be repeated. The measurements are as follows:

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Dark-blue to grayish-blue, impure limestone with shale partings. <i>Orthoceras mackenzicum</i> and <i>Favosites</i> cf. <i>niagarensis</i> are found especially in the upper 20 feet.				
Center of syncline 5 feet above base of unit.....	70	0	109	0
Limestone, dark and impure.....	2	0	39	0
Black, calcareous shale carrying many ostracods.....	2	0	37	0
Thin-bedded limestone and shale in about equal amounts	11	0	35	0
Drab shale	2	0	24	0
Thick-bedded limestone with thin shale partings.....	11	0	22	0
Interbedded limestone and shale in thin beds.....	5	6	11	0
Thick-bedded massive limestone and shale in thin beds	4	0	7	0
Drab shale	1	3	1	6
Thin limestone band containing 6 inches below top <i>Klædenella nitida</i> , <i>Dizygopleura halli</i> , <i>D. intermedia</i> <i>D. perrugosa</i> , <i>Beyrichia moodyi</i>	0	3	20	6
Thickness of McKenzie formation described....			109	0
ROCHESTER FORMATION				
Thick-bedded limestone bearing <i>Whitfieldella marylandica</i>	3	0	64	11
Dark-gray shale with thin limestone beds. About this horizon is <i>Stropheodonta corrugata</i> var. <i>pleuristriata</i>	6	0	61	11
Interbedded blue limestone and drab shale. Two feet above base occurs <i>Drepanellina ventralis</i>	7	10	55	11

¹ The Rose Hill formation receives its name from the section at the northern end of Rose Hill in Cumberland, described on page 68.

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Dark, bluish-gray fine-grained limestone containing many light-colored lenses of limestone forming a limestone conglomerate	1	0	48	1
Drab shale above. At base a bed of black limestone 8 inches thick with light-colored spots in it in many places, containing <i>Favosites</i> sp., <i>Whitfieldella marylandica</i> , <i>Echmina spinosa</i> , <i>A. ventralis</i> , <i>Drepanellina ventralis</i> . The base of this unit is 123 feet east of the top of the Keefer sandstone.....	1	2	47	1
Drab shale. A thin band of limestone in the middle abounds in <i>Whitfieldella marylandica</i> , bears also <i>Schuchertella elegans</i> , <i>Tentaculites niagarensis</i>	0	9	45	11
Limestone bed made up in large part of <i>Whitfieldella marylandica</i> but contains also <i>Schuchertella subplana</i> , <i>Drepanellina clarki</i> , <i>Dizygopleura asymmetrica</i> , <i>Echmina abnormalis</i> , <i>A. spinosa</i> , <i>Aparchites alleghaniensis</i> , <i>Beyrichia veronica</i> . The base of this bed is 103 feet east of the top of the Keefer sandstone	0	11	45	2
Drab shale bearing <i>Pholidops squamiformis</i> . At base is a thin limestone band containing <i>Schuchertella subplana</i> , <i>Drepanellina clarki</i> , <i>Dizygopleura asymmetrica</i> , <i>D. proutyi</i> , <i>Echmina abnormalis</i> , <i>A. spinosa</i> , <i>Aparchites alleghaniensis</i>	1	4	44	3
Drab shale above. Thin gray limestone at base contains <i>Schuchertella elegans</i> common, <i>S. subplana</i> , <i>Whitfieldella marylandica</i> , <i>Drepanellina clarki</i> , <i>Dizygopleura asymmetrica</i> , <i>D. proutyi</i> , <i>Echmina abnormalis</i> , <i>A. spinosa</i> , <i>Aparchites alleghaniensis</i> , <i>Beyrichia veronica</i>	0	9	42	11
Drab shale above. At base a band of limestone contains <i>Cornulites concavus</i> , <i>Pholidops squamiformis</i> , <i>Schuchertella elegans</i> , <i>Dalmanites elegantula</i> , <i>Camarotæchia neglecta</i> , <i>Whitfieldella marylandica</i> , <i>Tentaculites niagarensis</i>	1	1	42	2
Drab shale above bearing <i>Reticularia bicostata</i> . At base a platy limestone contains <i>Stropheodonta corrugata</i> var. <i>pleuristriata</i> , <i>S. deflecta</i> , <i>Drepanellina clarki</i> , <i>Dizygopleura symmetrica</i> , <i>D. proutyi</i> , <i>Echmina abnormalis</i> , <i>A. spinosa</i>	1	1	41	1
Fissile, dark-gray shale carrying <i>Whitfieldella marylandica</i> , <i>Pterinea emacerata</i> , <i>Tentaculites niagarensis</i> . A thin band of limestone at base contains <i>Cornulites rosehillensis</i> , <i>Stropheodonta corrugata</i> , <i>Dalmanella elegantula</i> , <i>Camarotæchia neglecta</i> , <i>Whit-</i>				

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
<i>Whitfieldella marylandica</i> , <i>Homalonotus delphinocephalus</i> , <i>Dalmanites limulurus</i> , <i>Drepanellina clarki</i> , <i>Dizygopleura symmetrica</i> , <i>Echmina abnormis</i> , <i>A. spinosa</i> , <i>Beyrichia veronica</i>	2	1	40	0
Interbedded drab shale and dark-gray limestone. A band of limestone at the top contains <i>Cornulites concavus</i> , <i>Pholidops squamiformis</i> , <i>Stropheodonta corrugata</i> , <i>Spirifer</i> sp., <i>Reticularia bicostata</i> , <i>Whitfieldella marylandica</i> , <i>Homalonotus lobatus</i> . A thin band of limestone at base contains <i>Dalmanella elegantula</i> , <i>Whitfieldella marylandica</i> very abundant, <i>Dalmanites limulurus</i>	1	8	37	0
Drab shale bearing <i>Camarotoechia neglecta</i> . A band of limestone at base contains <i>Cornulites rosehillensis</i> , <i>Stropheodonta corrugata</i> , <i>Camarotoechia neglecta</i> , <i>Atrypa reticularia</i> , <i>Whitfieldella marylandica</i> , <i>Tentaculites niagarensis</i> var. <i>cumberlandia</i> , <i>Homalonotus delphinocephalus</i> , <i>H. lobatus</i> , <i>Dalmanites limulurus</i> , <i>Drepanellina clarki</i> , <i>Dizygopleura symmetrica</i> , <i>D. proutyi</i>	1	4	36	3
Drab shale with <i>Pterinea emacerata</i> . At base a grayish-blue crystalline limestone forms a projecting ledge. The limestone contains <i>Stropheodonta corrugata</i> var. <i>pleuristriata</i> , <i>Pholidops squamiformis</i> , <i>Camarotoechia neglecta</i> , <i>Diaphorostoma niagarensis</i> , <i>Encrinurus ornatus</i> , <i>Homalonotus delphinocephalus</i> , <i>H. lobatus</i> , <i>Drepanellina clarki</i> , <i>Dizygopleura symmetrica</i> , <i>D. proutyi</i>	2	0	34	11
Drab shale with bands of crystalline gray limestone. Limestone lenses contain in upper part <i>Stropheodonta corrugata</i> , <i>S. deflecta</i> , <i>Dalmanella elegantula</i> , <i>Camarotoechia neglecta</i> , <i>Reticularia bicostata</i> var. <i>marylandica</i> , <i>Dalmanites limulurus</i> , <i>Drepanellina clarki</i> , <i>Dizygopleura symmetrica</i> , <i>D. asymmetrica</i> , <i>Echmina abnormis</i> , <i>A. spinosa</i> . One foot above base occurs <i>Conularia niagarensis</i> . A thin band of limestone at base contains <i>Stropheodonta corrugata</i> , <i>Leptæna rhomboidalis</i> , <i>Dalmanella elegantula</i> , <i>Camarotoechia neglecta</i> , <i>Conularia niagarensis</i>	5	0	32	11
Dark-gray fissile shale bearing <i>Reticularia bicostata</i> . Impure platy limestone at base contains <i>Stropheodonta corrugata</i> , <i>S. corrugata</i> var. <i>pleuristriata</i> , <i>S. deflecta</i> , <i>Camarotoechia neglecta</i> , <i>Drepanellina clarki</i> , <i>Dizygopleura symmetrica</i> , <i>Echmina abnormis</i> , <i>A. spinosa</i>	2	0	27	11

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Dark-gray fissile shale. At base is a thin limestone band containing <i>Dalmanites limulurus</i>	1	4	25	11
Dark-gray fissile shale bearing <i>Cornulites concavus</i> , <i>C. rosehillensis</i> , <i>Leptæna rhomboidalis</i> , <i>Schuchertella subplana</i> , <i>Atrypa reticularis</i> , <i>Spirifer crispus</i> , <i>Bucanella trilobata</i> , <i>Diaphorostoma niagarensense</i>	4	11	24	7
Interbedded, thin gray limestone and fissile gray shale bearing <i>Stropheodonta corrugata</i> , <i>Dalmanella elegantula</i> , <i>Platyceras unguiforme</i> , <i>Diophorestoma niagarensense</i> , <i>Drepanellina clarki</i> , <i>Dizygopleura symmetrica</i> , <i>Æchmina abnormis</i>	1	4	21	3
Dark-gray, fissile argillaceous shale with thin bands of crystalline limestone. A band 5 feet above base contains <i>Stropheodonta corrugata</i> , <i>Leptæna rhomboidalis</i> , <i>Schuchertella tenuis</i> , <i>Rhipidomella hybrida</i> , <i>Atrypa reticularis</i> , <i>Spirifer crispus</i> , <i>Pterinea emacerata</i> , <i>Hormatoma</i> sp., <i>Poleumita</i> sp., <i>Platyceras unguiforme</i> , <i>Diphorestoma niagarensense</i> , <i>Homalonotus lobatus</i> . A band 3 feet above the base contains <i>Stropheodonta corrugata</i> , <i>Dalmanella elegantula</i> , <i>Camartæchia neglecta</i> , <i>Uncinulus stricklandi</i> , <i>Homalonotus delphinocephalus</i> , <i>Dalmanites limulurus</i> , <i>Drepanellina clarki</i> , <i>Dizygopleura symmetrica</i> , <i>Æchmina abnormis</i> , <i>A. spinosa</i>	7	0	19	11
Gray sandstone stained red.....	0	6	12	11
Fossiliferous oölitic iron ore. The <i>Roberts iron ore</i> ..	0	8	12	5

Keefer Sandstone Member

Shaly sandstone, brownish above base.....	1	11	11	9
Massive gray sandstone with many cavities $\frac{1}{2}$ inch in diameter and many small tubular openings.....	8	0	9	10
Shaly sandstone	1	10	1	10
Thickness of Rochester formation.....			64	11

ROSE HILL FORMATION

Interbedded shale and calcareous sandstone.....	3	0	..	..
Fissile shale	5	0	..	..
Light-gray limestone containing <i>Chonetes novascoticus</i> , <i>Calospira sulcata</i> abundant.....	0	6	..	..

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Olive to brown shale interbedded with thin, slightly calcareous sandstone. The upper 30 feet of this unit are seen in the railroad cut, the underlying beds are poorly exposed west of the cut. This unit contains <i>Atrypa reticularis</i> , <i>Calospira sulcata</i> , and <i>Bucanella trilobata</i>	90	0	..	..
Thickness of Rose Hill formation exposed.....			98	6

The thickness assigned the Rochester formation is much greater in this section than elsewhere in Maryland. The McKenzie-Rochester contact is not marked clearly by lithological change but is determined by change in the ostracod faunas.

V. Section at Cumberland

The best and most carefully studied section of the Rose Hill formation in Maryland is at the north end of Rose Hill, Cumberland, from which locality the formation receives its name. The section is seen along the Western Maryland Railway and in its immediate vicinity east of the "Narrows," the gorge cut by Wills Creek through Wills Mountain. This locality affords a nearly continuous exposure of the strata between the top of the Tuscarora formation and the *Whitfieldella marylandica* zone at the top of the Rochester formation. About 100 feet of the immediately overlying beds of the McKenzie formation are also poorly exposed on Camp Hill along the top of the cliff immediately overlooking Wills Creek. The McKenzie-Wills Creek contact is, however, finely shown west of the old cement quarry.

A shale having a faint reddish tone is seen 313 feet east of the Keefer sandstone and appears to occupy approximately the position of the red bed so prominent in the middle of the McKenzie formation east of Hancock.

The contact of the Rose Hill and the Tuscarora formations is admirably exposed, showing that the formations are connected, locally, by transitional beds.

WILLS CREEK FORMATION

Bloomsburg Member

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
The section is exposed in cliff east of cement quarry.				
Compact sandstone, upper 8 inches red, lower bed greenish	3	6	3	6

McKENZIE FORMATION ¹

Thin-bedded argillaceous sandstone; greenish above, dark below with numerous worm borings parallel to bedding	6	0	294	7
Dark shale, fossiliferous above, worm borings below...	4	0	288	7
Fissile drab shale with thin bands of limestone above, concealed below. The upper 50 feet of this unit contains <i>Dizygopleura acuminata</i> , <i>D. swartzi</i> , <i>D. carinata</i> , <i>Euklædenella punctiliosa</i> . The middle part of the unit bears <i>Æchmina depressa</i> , <i>Klædenella nitida</i> , <i>K. scapha-brevicula</i> , <i>K. immersa</i> , <i>Dizygopleura per-rugosa</i> , <i>Euklædenella sinuata proclivis</i> , <i>Bythocypris obesa</i>	175	0	284	7
The section is continued in the bluff overlooking the Western Maryland Railway.				
Shale, faint reddish tone, exposed 313 feet east of Keefer sandstone. Thickness about.....	5	0	109	7
Shale with numerous thin beds of limestone. The upper part of this unit abounds in <i>Hormatoma marylandica</i> , <i>H. hopkinsi</i> , <i>Orthoceras</i> sp. About 25 feet above the base of this unit occur <i>Dizygopleura subdivisa</i> , <i>D. intermedia</i> . Thickness about.....	100	0	104	7
Dark limestone with a bed of shale 11 inches thick in its middle	2	9	4	7
Drab shale. At its base is a bed of dark-gray limestone 9 inches thick with many calcite veins. Surface weathering light gray, in part a limestone conglomerate	1	10	1	10
Total thickness of McKenzie formation.....			294	7

¹ The distance between the top of the Keefer sandstone and the base of the Cedar Cliff limestone lens in the Bloomsburg red sandstone is 640 feet S. 61° E. (measured by tape). The average dip of the rocks between these points is 32° 18' as a result of 31 observations. This gives a thickness of 294 feet for the McKenzie formation.

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Drab, fissile shale. At its base is a band of dark-colored, fine-grained limestone with many calcite veins and many <i>Whitfieldella marylandica</i>	2	0	46	1
Drab to olive, argillaceous shale with numerous <i>Whitfieldella marylandica</i> . At its base is a bed of limestone containing <i>Whitfieldella marylandica</i> and ostracods	1	2	44	1
Olive to drab shale.....	9	0	42	11
Grayish-blue limestone containing <i>Pholidops squamiformis</i> , <i>Stropheodonta corrugata</i> , <i>Camarotæchia neglecta</i> , <i>Whitfieldella marylandica</i> , <i>Dalmanites limulus</i> , <i>Æchmina spinosa</i> , <i>A. abnormis</i> , <i>A. postica</i> , <i>A. cumberlandia</i> , <i>Dizygopleura proutyi</i> , <i>D. symmetrica</i> , <i>D. asymmetrica</i> , <i>Aparchites alleghaniensis</i> , <i>Beyrichia veronica</i> , <i>Primitia resseri</i> , <i>Drepanellina clarki</i> , <i>D. modesta</i>	0	6	33	11
Drab shale containing <i>Camarotæchia neglecta</i>	2	0	33	5
Bluish-gray limestone bearing <i>Cornulites cf. concavus</i> , <i>Stropheodonta corrugata</i> , <i>Camarotæchia neglecta</i> , <i>Dalmanella elegantula</i> , <i>Whitfieldella marylandica</i> , <i>Homalonotus lobatus</i>	0	8	31	5
Drab shale. A bed of grayish-blue medium-grained limestone bears <i>Stropheodonta corrugata</i> , <i>Schuchertella elegans</i> , <i>Dalmanella elegantula</i> , <i>Camarotæchia neglecta</i> , <i>Atrypa reticularis</i> , <i>Conularia sp.</i> , <i>Homalonotus delphinocephalus</i> , <i>Dalmanites limulus</i>	1	0	30	9
Drab shale. At its base is a band of shaly sandstone carrying <i>Stropheodonta corrugata</i> , <i>Leptæna rhomboidalis</i> , <i>Camarotæchia neglecta</i> very abundant, <i>Homalonotus delphinocephalus</i> , <i>H. lobatus</i>	1	2	29	9
Drab to olive shale.....	8	0	28	7
Crystalline gray limestone containing <i>Cornulites concavus</i> , <i>Stropheodonta corrugata</i> , <i>S. deflecta</i> , <i>Leptæna rhomboidalis</i> , <i>Dalmanella elegantula</i> , <i>Rhipidomella hybrida</i> , <i>Camarotæchia neglecta</i> , <i>Atrypa reticularis</i> , <i>Reticularia bicostata</i> , <i>Platyceras niagarensis</i> , <i>P. unguiforme</i> , <i>Diaphorostoma niagarensis</i> , <i>Homalonotus delphinocephalus</i> , <i>H. lobatus</i> , <i>Dalmanites limulus</i>	0	8	20	7
Olive to drab shale.....	4	0	19	11
Crystalline gray limestone, bearing <i>Favosites favosus</i> , <i>Cornulites rosehillensis</i> , <i>Stropheodonta corrugata</i> , <i>Dalmanella elegantula</i> , <i>Rhipidomella hybrida</i> , <i>Camarotæchia neglecta</i> , <i>Spirifer crispus</i> , <i>Platyceras unguiforme</i> , <i>Liopteria subplana</i> , <i>Diaphorostoma niagarensis</i> , <i>Stylolina sp.</i> , <i>Coleolus sp.</i> , <i>Homalonotus delphinocephalus</i> , <i>Dalmanites limulus</i>	0	5	15	11

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Olive to drab shale carrying <i>Uncinulus stricklandi</i> , <i>Sphyrodocus</i> cf. <i>desplainense</i>	4	0	15	6
Iron ore. <i>Roberts iron ore</i>	0	6	11	6

Keefer Sandstone Member

Massive sandstone. Upper 2 feet very calcareous, lower foot iron-stained and carrying the following poorly-preserved fossils: *Camarotoechia neglecta*, *Liocalymmene clintoni*, *Stropheodonta* sp., crinoid stems.....

	11	0	11	0
Total thickness of Rochester formation.....			46	1

ROSE HILL FORMATION

The section is continued along the road leading southwest from the top of the bluff. The traverse begins at the base of the Keefer sandstone about 700 feet southwest of the railroad and extends 681 feet towards the west. Average strike and dip N. 34° E. 37° E.

Traverse S. 83° W. 200 feet

Thin-bedded olive to drab argillaceous shale, with occasional thin sandstone beds, carrying near base <i>Dalmanella elegantula</i> , <i>Atrypa reticularis</i> , <i>Cælospira sulcata</i> , <i>Tentaculites minutus</i> , <i>Liocalymmene clintoni</i> , <i>Mastigobolbina typus</i> , <i>Plethobolbina cornigera</i> , <i>P. typicalis</i> , <i>Dizygopleura symmetrica</i> , <i>Bonnemaia celsa</i>	20	0	552	0
Purplish to reddish, thin-bedded argillaceous shale....	6	0	532	3
Olive to light-red argillaceous shale, carrying <i>Tentaculites minutus</i>	2	0	526	0
Thin-bedded drab argillaceous shale with some reddish to purple layers and occasional beds of sandstone, carrying 10 feet below the top many <i>Atrypa reticularis</i> . Fifteen feet below the top <i>Chonetes novascoticus</i> ; 18 feet below the top <i>Orthis</i> sp.; 21 feet below top <i>Dalmanella elegantula</i> , <i>Cælospira sulcata</i> , <i>Liocalymmene clintoni</i> ; 38 feet below the top <i>Cælospira hemispherica</i>	42	0	524	0
Olive to purple shale and a few thin sandstone layers containing many <i>Cælospira sulcata</i> . This and the next unit constitute the <i>Bonnemaia rudis</i> zone containing <i>Bonnemaia obliqua</i> , <i>B. pulchella</i> , <i>B. longa</i> , <i>Mastigobolbina virginica</i>	12	0	482	0

Traverse S. W. ¹	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Reddish, fissile shale.....	8	0	470	0
Thin-bedded, argillaceous shale with occasional thin beds of sandstone containing <i>Buthotrephis</i> cf. <i>gracilis</i> var. <i>Zygosella postica</i>	112	0	462	0
Concealed	5	0	350	0
The section is continued on the bluff south of the railroad and east of the ravine. The units were measured directly.				
Rusty to gray argillaceous shale bearing <i>Camarotæchia neglecta</i>	1	0	345	0
Concealed	12	0	344	0
Rusty-gray to olive, argillaceous shale bearing in places numerous <i>Buthotrephis</i> sp. The base of this unit is at the foot of the hill on the east side of the valley, near the railroad.....	15	0	332	0
Concealed in valley, probably shale.....	20	0	317	0
The section is continued in a small cross valley a few hundred feet southwest of the railroad track.				
Rusty-gray to brown, argillaceous shale with some sandstone bands; not well exposed. The top of this exposure is east of the road and opposite a path leading up hill to an old powder house.....	21	0	297	0
Argillaceous shale becoming dark-colored and brown toward the top, with some ferruginous sandstone layers, 1 to 2 inches thick, bearing <i>Camarotæchia neglecta</i> , <i>Tentaculites minutus</i> , and numerous ostracods. The beds are not well exposed here but are seen in path leading up hill southwest of the powder house	20	0	276	0
Rusty-gray to olive argillaceous shale with thin beds of sandstone near top, which bear <i>Tentaculites minutus</i> , <i>Calymmene crespensis</i> and many ostracods....	11	0	256	0
Mottled shale containing <i>Buthotrephis</i> sp. At its base is a sandstone containing <i>Camarotæchia neglecta</i> , <i>Calymmene crespensis</i>	18	0	245	0
Rusty-gray to olive shales with two conspicuous sandstone beds about 6 inches thick, one 8 feet from top and one 4 feet from bottom. The shale contains fewer specimens of <i>Buthotrephis</i> than the beds be-				

¹ Traverse S. 73° W. from 200 to 336

S. 63° W. from 336 to 491

S. 55° W. from 491 to 581

S. 49° W. from 581 to 681, elevation at end 7 feet below point of beginning.

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
low. The sandstone at the top bears <i>Chonetes novascoticus</i> , <i>Tentaculites minutus</i> , <i>Calymmene</i> sp., and a very striated <i>Conchidium</i> ?. The lower sandstone layer contains the following fossils: <i>Butrotrephis</i> cf. <i>gracilis</i> var., <i>Chonetes</i> sp., <i>C. novascoticus</i> , <i>Camarotæchia neglecta</i> , <i>Calospira hemispherica</i> , <i>Tentaculites minutus</i> , <i>Calymmene cresapensis</i> , <i>Homalonotus delphinocephalus</i> , and many ostracods. About 3 feet from bottom occurs a thin layer of shale which contains numerous <i>Calospira hemispherica</i> and <i>Calymmene blumenbachii</i> var. <i>macrocephalus</i> ..	23	0	226	9
Dark, fissile, rusty and knotty arenaceous shale bearing many plant remains. At its base is a sandstone lens carrying <i>Buthotrephis gracilis</i> , <i>Calymmene</i> cf. <i>cresapensis</i>	8	6	203	9
Fissile, argillaceous rusty shale with two sandstone layers near center. Upper sandstone contains <i>Camarotæchia neglecta</i> , <i>Calymmene</i> sp., <i>Mastigobolbina lata</i>	17	0	195	3
The section is continued along the Western Maryland Railway at the east end of the gap.				
Red iron sandstone consisting of red ferruginous sandstone and interbedded shale, the latter 4 inches thick. The sandstone contains so much hematite as to approach a low-grade oölitic iron ore. <i>Cresaptown iron sandstone</i>	10	4	178	3
Argillaceous shale bearing <i>Camarotæchia neglecta</i> crinoid stems, <i>Mastigobolbina lata</i> , <i>Zygoseella brevis</i> , <i>Zygobolba arcta</i> , <i>Z. bimuralis</i> , <i>Zygobolbina conradi</i> , <i>Z. conradi latimarginata</i>	6	0	167	11
Arenaceous shale with heavy lenses of quartzitic sandstone containing <i>Camarotæchia neglecta</i> , <i>Orthoceras</i> sp.	6	0	161	11
Slightly arenaceous, rusty shale weathering into small rectangular fragments, as a rule thin-bedded and fissile with an occasional thin sandstone layer. Eleven feet below the top of this unit occurs <i>Nuculites</i> sp., 20 feet below top <i>Camarotæchia neglecta</i> , <i>Calospira hemispherica</i> , <i>Mastigobolbina lata</i> , <i>M. vanuxemi</i> , <i>M. clarkei</i> , <i>Chilobolbina punctata bicornis</i> , <i>C. billingsi</i> , <i>Zygobolbina conradi</i> , <i>Z. conradi latimarginata</i> . The rocks under the southeast leg of water tank are 38 feet stratigraphically below the top of this unit where occurs <i>Ctenodonta willsi</i>	98	0	155	11

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Arenaceous rusty and hackly shale, a band of sandstone at its base. Near top of this unit are found <i>Aparchites variolatus</i> , <i>Zygobolba minima</i> , <i>Beyrichia emaciata</i> , <i>Plethobolbina cribraria</i>	4	4	57	11
Fissile shale mottled with plant remains.....	1	0	53	7
Sandstone somewhat ferruginous and having irregular surface	3	0	52	7
Shaly sandstone	2	0	49	7
Hard sandstone with shale partings.....	1	6	47	7
Hackly, rusty, greenish shale.....	6	6	46	1
Grayish to dark-green sandstone.....	2	2	39	7
Argillaceous shale, dark-green and somewhat rusty above. Gray sandstone below.....	1	11	37	5
Argillaceous shale above; dark, fine-grained sandstone below	1	11	35	6
Arenaceous shale with thin sandstone layers with a prominent, dark-green sandstone 6 inches thick at base	16	6	33	7
Argillaceous shale and some thin sandstone bands having a fossil that resembles <i>Caudagalli</i> . The surfaces of the sandstone beds have irregularly-winding, tubular prominences resembling worm borings.....	5	0	17	1
Argillaceous sandstone and some interbedded sandy shale. Some of the lower beds of sandstone contain many clay balls	3	10	12	1
Thin-bedded, reddish sandstone with a few clay balls..	4	0	8	3
Arenaceous shale with many black carbonaceous bands resembling plant stems.....	0	10	4	3
Argillaceous sandstone, stained yellow.....	1	1	3	5
Interbedded shale and thin sandstone layers.....	2	4	2	4
Total thickness of the Rose Hill formation.....			552	0

TUSCARORA FORMATION

Hard sandstone penetrated by numerous rusty small tubes	5	4	38	0
Rusty sandstone with many lenses of clay. A shale layer contains <i>Camarotoechia neglecta</i>	0	8	32	8
Hard, heavy-bedded sandstone.....	3	0	32	0
Hard sandstone and thin interbedded layers of sandy shale, 1 to 3 feet thick containing a few worm borings and some clay balls.....	9	0	29	0
Massive, white sandstone bearing <i>Arthropycus allegheniensis</i>	20	0	20	0

*B. Sections in Evitts Mountain Anticline**VI. Sections near the Six-Mile House*

Three excellent, partial sections of the McKenzie, Rochester, and Rose Hill formations are seen in the vicinity of the Six-Mile House, a hotel located on the National Road, six miles east of Cumberland. The combined exposures give a nearly complete section of the McKenzie, Rochester, and the upper and middle beds of the Rose Hill formations.

A. Section of Upper Part of McKenzie Formation

A fine exposure of the upper part of the McKenzie formation is seen upon a county road leading south from the National Road about $\frac{1}{2}$ mile west of the Six-Mile House. The section described is situated about $\frac{1}{2}$ mile south of the National Road. It is unfortunately complicated by folds so that measurements are difficult and it is probable that the thicknesses given below are excessive. The locality is of interest because of the marked development of the Hormatoma zone, certain of the beds containing such a profusion of gastropods of this genus as to form a veritable coquina.

WILLS CREEK FORMATION	Horizontal distance from beginning to bottom of beds Feet	Thickness	
		Beds Feet	Total Feet
<i>Bloomsburg Member</i>			
Green sandstone, stained brown containing <i>Leperditia</i> <i>alta</i>	..	2.4	9.0
Red, arenaceous shale.....	..	3.0	6.6
Massive red sandstone.....	..	3.6	3.6
Thickness of Bloomsburg member described....			9.0

McKENZIE FORMATION**Traverse N. 33° W.**

Approximate altitude of beginning of section 1080 feet

A. T. on topographic map.

Thick-bedded arenaceous shale, N. 73° E. 70° E.	16.0	4.5	300.4
Fissile, green, somewhat arenaceous shale, its lower portion more compact, N. 80° E. 7° E.	47.0	7.8	295.9
Concealed	129.0	19.0	288.1
Fissile green shale, partly concealed. N. 80° E. 6° E..	142.2	2.7	291.1
Fissile gray shale, N. 55° E. 6° E. At top occurs a thin bed of dark-blue limestone containing <i>Camarotoechia andrewsi</i> , <i>Homœspira evax</i> var. <i>marylandica</i> , <i>Klædenella nitida</i> , <i>Dizygopleura halli</i> , <i>D. intermedia</i> , <i>D. perrugosa</i> , <i>Beyrichia moodyi</i>	108.2	10.1	266.4

Traverse N. 86° W. Altitude of turn 1058 A. T.	Horizontal distance from begin- ning to bot- tom of beds Feet	Thickness	
		Beds Feet	Total Feet
Concealed. Some fissile gray shale, N. 67° E. 10° E. .	242.2	11.0	256.3
Fissile shale, N. 20° E. 10° E. At top occurs a blue fossiliferous limestone 8 inches thick containing numerous <i>Camarotæchia andrewsi</i>	258.2	3.4	245.3
Fissile gray shale, N. 57° E. 6° E. and N. 35° E. 10° E. At top occurs a thin bed of limestone containing <i>Klædenella nitida</i> , <i>Dizygopleura halli</i> , <i>D. intermedia</i> , <i>D. perrugosa</i> , <i>Beyrichia moodyi</i>	265.2	1.2	241.9
Gray fissile shale, N. 30° E. 10° E. At top occurs a thin limestone containing <i>Pterinea flintstonensis</i> . .	270.7	1.0	240.7
Fissile shale. At top is a thin band of limestone con- taining <i>Homæospira evax</i> var. <i>marylandica</i>	272.2	0.7	239.7
Fissile shale. At top occurs a limestone 7 inches thick containing <i>Camarotæchia andrewsi</i> and <i>Pterinea</i> <i>flintstonensis</i> . At 277 feet horizontally occurs <i>Homæospira evax</i> var. <i>marylandica</i> abundant and <i>Pterinea flintstonensis</i>	282.2	2.4	239.0
Fissile shale. In a thin band of limestone at top oc- curs <i>Pterinea flintstonensis</i> and numerous ostracods. .	282.2	0.8	236.6
Fissile shale. A thin band of fossiliferous limestone at top	300.2	4.8	235.8
Fissile shale. At the top in a band of limestone 4 inches thick occurs <i>Camarotæchia andrewsi</i> in great abundance	312.2	4.3	231.0
Fissile shale. At the top occurs a fossiliferous lime- stone 4 inches thick containing <i>Camarotæchia an-</i> <i>drewsi</i> abundant and <i>Clidophorus nitidus</i>	330.8	5.1	226.7

Traverse N. 55° W. Altitude of turn 1039 A. T.

Fissile shale. At the top is blue limestone in courses 6 inches thick, interbedded with shale, containing <i>Orbiculoidea clarki</i> , <i>Camarotæchia andrewsi</i> , <i>Pteri-</i> <i>nea flintstonensis</i> common, ostracods.	354.8	7.3	221.6
Fissile shale, N. 55° E. 10° E. At the top a thin bed of limestone contains <i>Homæospira evax</i> var. <i>mary-</i> <i>landica</i> , <i>Pterinea flintstonensis</i> , <i>Dizygopleura halli</i> . .	378.3	7.9	214.3
Fissile shale. A bed of limestone 5 inches thick at top. N. 55° E. 14° E.	391.0	3.7	206.4
Fissile shale. Thin limestone at top. N. 65° E. 11° E. .	400.8	4.2	202.7
Fissile shale. A bed of limestone 6 inches thick at top. N. 47° E. 19° E.	406.8	2.7	..
Strata repeated by a minor fold between 406.8 and 420.9	420.9	..	198.5

Traverse N. 39° W. Altitude of turn 1027 A. T.	Horizontal distance from begin- ning to bot- tom of beds Feet	Thickness	
		Beds Feet	Total Feet
Fissile gray shale. At the top are beds of brown and blue limestone, N. 25° E. 30° E. and N. 35° E. 30° E.	439.1	10.8	195.8
Fissile shale, N. 55° E. 12° E. and N. 45° E. 14° E. A band of limestone 5 inches thick at top contains <i>Clidophorus nitidus</i> , <i>Orthoceras</i> sp., ostracods.....	457.9	6.2	185.0
Fissile shale. A bed of limestone 10 inches thick at top contains <i>Orbiculoidea clarki</i> rather numerous, <i>Rhipidomella hybrida</i> , <i>Homæospira evax</i> var. <i>marylandica</i> very numerous and large.....	478.9	6.7	178.8
Fissile shale. A thin band of limestone at top contains <i>Rhipidomella hybrida</i> , <i>Camarotoechia andrewsi</i> , <i>Homæospira evax</i> var. <i>marylandica</i> . At 483.4 occur numerous ostracods	483.4	1.50	132.1
Fissile shale. At top is a thin bed of limestone.....	497.9	5.61	130.6
Interbedded blue limestone and fissile shale. At the top a thin bed of limestone contains <i>Camarotoechia andrewsi</i> abundant, cf. <i>Pterinea flintstonensis</i> . At 508.7 and 517 feet horizontally <i>Homæospira evax</i> var. <i>marylandica</i> occurs in great numbers.....	582.3	30.8	125.6
Concealed in part. This interval consists of shale with a few thin interstratified beds of limestone. A single course of limestone 5 inches thick occurs at 636.8 horizontally, 15.7 feet below top of unit, containing <i>Dalmanella elegantula</i> . N. 55° E. 14° E. At two other points the rocks dip 6° E. and 8° E....	639.3	22.1	134.8

Traverse N. 33° W. Altitude of turn 998 A. T.

Largely concealed. In part interbedded shale and limestone N. 55° E. 10° E. N. 55° E. 14° E. N. 35° E. 3° E. At 393 feet horizontally, 9 feet below top of unit, occurs a bed of limestone containing numerous unidentified pelecypods	772.3	28.5	112.7
The underlying beds are much folded, their thickness being measured directly.			
Thin-bedded limestone and some interbedded drab shale. The limestone beds vary from 1 to 6 inches in thickness. The bottom of this unit is terminated apparently by a thrust fault. In this unit occur <i>Homæospira evax</i> var. <i>marylandica</i> , <i>Pterinea flintstonensis</i> common, <i>Hormatoma hopkinsi</i> common, ostracods	788	4.5	784.2
Center of minor anticline.....	793	..	..

	Horizontal distance from begin- ning to bot- tom of beds Feet	Thickness	
		Beds Feet	Total Feet
Thrust fault, displacement slight. The underlying beds may be repeated but the section is described as though no repetition occurred.....	794	..	..
Crystalline limestone. This bed contains <i>Camarotochia andrewsi</i> , <i>Homæospira evax</i> var. <i>marylandica</i> , <i>Pterinea flintstonensis</i> , <i>Hormatoma</i> sp. in great profusion, and ostracods. A foot above the bottom of this unit is a bed of limestone 7 to 9 inches thick, the upper surface of which is covered with numerous imperfectly preserved bryozoa. The <i>Hormatoma</i> zone	805.6	5.0	79.7
Beds between 806.5 and 854 are repeated by folding.			
At 854 occurs the 7-inch bed seen at 805 feet.....	854	..	..
Center of anticline.....	881	..	..
Center of anticline formed by crystalline limestone of <i>Hormatoma</i> zone.....	987.5	..	..
Sharp turn of road to left in descending hill.....	1000	..	..
Point of intersection of lines passing through center of road above and below turn.....	1081	..	..
Interbedded limestone and shale. Near the top of this unit occur <i>Homæospira evax</i> var. <i>marylandica</i> , <i>Whitfieldella</i> sp. small, <i>Pterinea flintstonensis</i>	..	1.0	74.7
Interbedded shale and limestone. The lower 2 feet of this unit consists largely of shale. 6.2 feet above base of unit occur <i>Pterinea flintstonensis</i> ; 4.4 feet above base occur <i>Homæospira evax</i> var. <i>marylandica</i> , <i>Hormatoma hopkinsi</i>	..	9.0	73.7
Concealed. This interval extends from center of the anticline seen at 88 feet horizontally to the center of the anticline exposed on the lower turn of the road	..	14.0	64.7
The remainder of the section is exposed on the lower turn of the road.			
Argillaceous limestone containing near base <i>Homæospira evax</i> var. <i>marylandica</i> and ostracods.....	..	0.8	50.7
Fissile drab shale with some interstratified thin beds of impure argillaceous and arenaceous limestone containing <i>Whitfieldella</i> cf. <i>marylandica</i> , <i>Hormatoma</i> sp., ostracoda.....	..	2.0	49.9
Interbedded argillaceous limestone and fissile shale. Three feet above base of unit occur <i>Homæospira evax</i> var. <i>marylandica</i> , <i>Hormatoma</i> sp., ostracoda. At the base occur <i>Lingula</i> sp., <i>Clidophorus nitidus</i> , ostracoda	..	3.5	47.9

	Horizontal distance from begin- ning to bot- tom of beds Feet	Thickness	
		Beds Feet	Total Feet
Hard, blue limestone penetrated by calcite veins, con- taining cf. <i>Orbiculoidea clarki</i> , <i>Homæospira evax</i> var. <i>marylandica</i> , ostracoda.....	..	0.4	44.4
Interbedded shale and argillaceous limestone contain- ing <i>Camartæchia andrewsi</i> , ostracoda.....	..	4.0	44.
Concealed	..	40	40
Approximate thickness of McKenzie formation exposed			300

B. Section of Lower McKenzie and Rochester Formations

This section is to be seen a little less than half a mile south of the National Road upon the second county road west of the Six-Mile House, leading south. It embraces the lower beds of the McKenzie formation and the entire Rochester formation.

McKENZIE FORMATION	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Fine-grained, dark limestone with an occasional dark shale parting. Many <i>Reticularia</i> cf. <i>bicostata</i> near base	5	0	15	11
Dark-blue limestone	2	0	10	11
Mostly olive to dark shale, beds of limestone at top and 1 foot above bottom. Lower limestone contains <i>Dalmanella elegantula</i> , <i>Reticularia bicostata</i> and <i>Euklædenella longula</i>	3	0	8	11
Dark olive argillaceous shale, some dark-blue impure limestone, much covered.....	3	5	5	11
Thick-bedded impure limestone, fine texture, some rusty spots and calcite veins.....	2	6	2	5
Total thickness of McKenzie formation exposed.			15	11

ROCHESTER FORMATION

Thin-bedded dark, fine-grained impure limestone and thin-bedded shale, containing <i>Drepanellina clarki</i> , <i>Dizygopleura proutyi</i> , <i>D. symmetrica</i> , <i>Echmina ab-</i> <i>normis</i> , <i>A. spinosa</i> , <i>A. postica</i> , <i>Beyrichia veronica</i> ...	3	9	56	11
Limestone containing <i>Whitfieldella marylandica</i>	0	4	53	2
Shale	0	5	52	10
Dark-gray limestone with white veins almost made up of <i>Whitfieldella marylandica</i>	0	8	52	5

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Drab shale. At its base a band of impure gray limestone contains <i>Pholidops squamiformis</i> , <i>Schuchertella elegans</i> , <i>Tentaculites</i> cf. <i>niagarensis</i> , <i>Drepanelina clarki</i> , <i>Dizygopleura symmetrica</i> , <i>D. proutyi</i> , <i>Echmina abnormalis</i> , <i>A. spinosa</i> , <i>Beyrichia veronica</i>	2	4	51	9
Drab shale. A bed of sandstone 8 inches thick at its base, contains <i>Stropheodonta corrugata</i> , <i>Dalmanella elegantula</i> , <i>Camarotæchia neglecta</i> , <i>Homalonotus delphinocephalus</i> , many crinoid rings. The fossils are poorly preserved.....	6	2	49	5
Drab shale. A thin band of sandstone at its base.....	7	3	43	3
Drab to olive shale carrying <i>Stropheodonta corrugata</i> throughout. <i>Camarotæchia neglecta</i> and <i>Uncinulus Stricklandi</i> occur 5 feet 6 inches above base or unit. <i>Dizygopleura symmetrica</i> and <i>Echmina spinosa</i> 4 feet above base. <i>Uncinulus stricklandi</i> and <i>Favosites</i> sp. 2 feet above base.....	13	6	36	0

Keefer Sandstone Member

Massive sandstone. Upper 18 inches ferruginous. Many <i>Camarotæchia neglecta</i> are found 1 foot 6 inches to 7 feet below top of this sandstone.....	22	6	22	6
Total thickness of Rochester formation.....			56	11

C. Section of the Upper Part of the Rose Hill Formation

This section begins at the base of the Keefer sandstone, just back of the Six-Mile House, and continues up the road leading to the north from immediately in front of the hotel. It terminates about 65 feet stratigraphically below the Cresaptown iron sandstone. The measurements in this portion of the section are approximate. The Keefer sandstone is about 20 feet thick.

ROSE HILL FORMATION	Thickness	
	Beds	Total
	Feet	Feet
Greenish to red shale with some sandstone and limestone beds. Toward the top are more limestone and more fossils. This unit contains <i>Stropheodonta corrugata</i> , <i>Dalmanella elegantula</i> , <i>Camarotæchia neglecta</i> , <i>Reticularia</i> cf. <i>bicostata</i> , <i>Oælospira sulcata</i> , <i>Liocalymmene clintoni</i> . Seven feet below top occur <i>Dizygopleura macra</i> , <i>Plethobolbina typicalis</i> , <i>Zygosella valata</i> , <i>Z. cristata</i> , <i>Mastigobolbina typus</i> , <i>M. typus angulata</i>	50	550

	Thickness	
	Beds Feet	Total Feet
Olive, more or less rusty shale with sandstone bands which thicken and become more fossiliferous toward the top. Upper portion of the unit contains <i>Camarotoechia neglecta</i> , <i>Tentaculites minutus</i> , and crinoid stems. Thirty feet below top occur <i>Zygosella vallata nodifera</i> , <i>Mastigobolbina nucula</i> , <i>M. ultima</i> . The <i>Bonnemaia rudis</i> zone.....	184	500
Dark-colored shale with thin sandstone layers and many indistinct impressions of plants.....	10	316
Hackly, arenaceous, greenish to brown shale containing <i>Cælospira hemispherica</i>	6	306
Olive, rusty, argillaceous shale carrying <i>Cælospira hemispherica</i> and <i>Tentaculites minutus</i>	43	300
Concealed	27	257
Dark-colored shale with sandstone in thin layers. This unit bears numerous faint plant impressions, <i>Stropheodonta</i> sp., <i>Camarotoechia neglecta</i> , <i>Calymmene cresapensis</i>	18	230
Rusty, olive, argillaceous shale with sandstone layers containing crinoid stems, <i>Dalmanella</i> cf. <i>elegatula</i> , <i>Cælospira hemispherica</i> , <i>C. sulcata</i> , <i>Calymmene</i> sp., <i>Mastigobolbina lata</i>	23	212
Red ferruginous sandstone ("iron ore") in two bands separated by shale parting, carrying in this immediate locality from 6 inches to 8 feet in thickness. The <i>Cresaptown iron sandstone</i> . Average thickness	4	189
Olive, and often rusty argillaceous shales with few fossils bearing <i>Camarotoechia neglecta</i> , <i>Cælospira hemispherica</i>	65	185
Concealed to base of formation. Estimated to be about.....	120	120
Approximate thickness of Rose Hill formation.....		550

C. Sections in Tussey Mountain Anticline

VII. Section at Flintstone

An excellent partial section of the McKenzie and Rochester formations and of the upper beds of the Rose Hill formation is exposed on Flintstone Creek, northwest of the village of Flintstone.

About 150 feet of the upper part of the McKenzie formation may be seen on the east bank of the creek, nearly $\frac{1}{2}$ mile in an air line north of the village. The middle beds of the McKenzie are largely concealed along the stream above this point though here and there they may be seen, but not with sufficient continuity to permit the construction of a section. The Rochester formation and the upper beds of the Rose Hill formation are

exposed near the mouth of a small branch which enters Flintstone Creek from the northeast 3500 feet, in an air line, northwest of the bridge at Flintstone. The lower strata are observed in the bed of the branch and on the east bank of the ravine, a short distance above its mouth.

The Rochester fauna occurs in profusion in the shale beds overlying the Keefer sandstone. *Dalmanites limulurus* is not confined, however, to these beds as in the Cumberland section, but is found also in the Keefer sandstone and a variety occurs in the immediately underlying beds. The upper shale beds of the Rochester formation are thinner than at Cumberland, while the Keefer sandstone is thicker. This locality, hence, clearly manifests conditions which are intermediate between those observed at Hancock and those seen at Cumberland, corresponding in this respect with its geographic position.

The *Uncinulus obtusiplicatus* zone of the Upper McKenzie occupies a position similar to that at which it occurs at Grasshopper Run and also contains fossils of Niagaran type as it does at the latter locality.

The section begins at the cliff formed by the Bloomsburg red sandstone on the east bank of Flintstone Creek, 2000 feet in an air line north of the village, and extends thence along the creek for a distance of $\frac{1}{3}$ mile, ending a short distance beneath the Keefer sandstone.

WILLS CREEK FORMATION	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
<i>Bloomsburg Member</i>				
Reddish-brown, fossiliferous sandstone.....	4	0	15	0
Reddish-brown, arenaceous shale	11	0	11	0

MCKENZIE FORMATION				
Olive to dark-gray platy shales, lower 7 feet interstratified with thin limestone and sandstone layers, carrying <i>Butrotrephis gracilis</i> var. <i>intermedia</i> , <i>Lingula</i> sp.	13	6	295	6
Massive dark, bluish-gray limestone with <i>Pterinea flintstonensis</i> poorly preserved, <i>Dizygopleura acuminata</i> , <i>D. acuminata prolapsa</i> , <i>D. swartzi</i> , <i>Homæospira</i> sp. is abundant toward bottom.....	5	6	282	0
Drab shale mostly concealed.....	14	0	276	6

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Interbedded drab shale and very fossiliferous dark-gray limestone containing <i>Pholidops</i> sp., <i>Dalmanella elegantula</i> , <i>Camarotæchia andrewsi</i> , <i>Uncinulus obtusiplicatus</i> , <i>Spirifer mackenzicus</i> , <i>Trematospira camura</i> , <i>Cuneamya ulrichi</i> , <i>Calymene niagarensis</i> var. <i>restrictus</i> , <i>Tentaculites</i> sp., crinoid stems, <i>Dizygopleura acuminata</i> , <i>D. swartzi</i> , and bryozoa. This horizon corresponds to that found 35 feet below the red layers of the Bloomsburg at Grasshopper Run	7	0	262	6
Gray shale	6	0	252	6
Interbedded dark shale and dark limestone, more shale than limestone, containing numerous <i>Camarotæchia andrewsi</i>	5	0	249	6
Mostly dark-gray shale. Some thin impure limestone containing <i>Camarotæchia andrewsi</i> abundant.....	5	0	244	6
Calcareous sandstone containing few fossils, including <i>Camarotæchia andrewsi</i> , <i>Homæospira evax</i> var. <i>marylandica</i> , <i>Pterinea flintstonensis</i> , <i>Tentaculites niagarensis</i> var. <i>cumberlandia</i>	1	0	239	6
Mostly shale, some thin impure limestone.....	3	0	238	6
Dark-colored limestone with thin shale parting. <i>Camarotæchia andrewsi</i> in great abundance.....	1	4	235	6
Drab shale	2	0	234	2
Interbedded dark-gray shale and thin-bedded dark-blue limestone. Limestone layers toward center carrying many <i>Camarotæchia andrewsi</i>	8	8	232	2
Impure dark limestone with <i>Homæospira evax</i> var. <i>marylandica</i> , <i>Æchmina inequalis</i> , <i>Kyammoides tricornis</i> , <i>Beyrichia mesleri</i> , <i>Euklædenella dorsata</i> , <i>E. sinuata</i> , <i>E. sinuata angulata</i> , <i>E. sinuata proclivis</i> , <i>Klædenella gibberosa</i> , <i>K. subovata</i> , <i>Dizygopleura gibba</i> , <i>D. punctata</i> , <i>D. bulbifrons</i> , <i>Bythocypris philipsiana</i>	1	0	223	6
Shale. <i>Butotrephes gracilis</i> var. <i>intermedia</i>	12	0	222	6
Sandstone, somewhat argillaceous and weathering yellow	1	0	120	6
Arenaceous shale above; at base a band of limestone 6 inches thick	2	6	209	6
Limestone weathering buff.....	3	6	207	0
Hackly shale	4	0	201	6
Dark-gray shale below, with 8 inches of black impure limestone at top containing <i>Lingula subtruncata</i> and many ostracods of the genera <i>Klædenella</i> , <i>Euklædenella</i> , <i>Dizygopleura</i>	12	8	197	6

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Impure limestone	0	6	184	10
Shale	1	0	184	4
Dark impure limestone	8	0	183	4
Dark-gray shale	2	10	175	4
Dark, impure limestone with shale parting.....	1	6	172	6
Interbedded gray shale and impure dark limestone about equal in amount	21	0	171	0
Concealed in large part. Lower beds dark limestone. About 30 feet above the base occur many <i>Euklædenella indivisa</i> , <i>E. umbonata</i> , <i>E. umbilicata</i> , <i>E. primitoides</i> , <i>E. primitoides minor</i> , <i>Klædenella scapha</i> , <i>K. transitans</i> , <i>Dizygopleura subdivisa</i> , <i>D. micula</i> , <i>D. pinguis</i> , <i>D. concentrica subquadrata</i> . About	150	0	150	0
Approximate thickness of McKenzie formation exposed			296	0

The ostracods of the McKenzie of this section are practically the same throughout every fossiliferous bed, comprising *Klædenella nitida*, *Dizygopleura halli*, *D. intermedia*, *D. perrugosa*, *Beyrichia moodyi*.

ROCHESTER FORMATION	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Dark-blue limestone containing numerous <i>Whitfieldella marylandica</i>	0	6	37	10
Dark-gray shale. At its base is a band of crystalline, gray, fossiliferous limestone containing <i>Stropheodonta corrugata</i> , <i>Leptæna rhomboidalis</i> , <i>Schuchertella tenuis</i> , <i>Dalmanella elegantula</i> , <i>Camarotoechia neglecta</i> , <i>Atrypa reticularis</i> , <i>Diaphorostoma niagarensis</i> , <i>Calymene niagarensis</i> , <i>Homalonotus delphinocephalus</i> , <i>H. lobatus</i> , <i>Dalmanites limulus</i>	8	4	37	4
Gray shale. At its base is a band of crystalline, gray limestone, very fossiliferous containing <i>Stropheodonta corrugata</i> , <i>Leptæna rhomboidalis</i> , <i>Camarotoechia neglecta</i> , <i>Atrypa reticularis</i> , <i>Diaphorostoma niagarensis</i> , <i>Dalmanites limulus</i>	9	4	32	0
Drab shale. At its base is a band of arenaceous limestone, very fossiliferous, carrying <i>Stropheodonta corrugata</i> , <i>Dalmanella elegantula</i> , <i>Camarotoechia neglecta</i> , <i>Uncinulus stricklandi</i> , <i>Homalonotus delphinocephalus</i> , <i>H. lobatus</i> , <i>Dalmanites limulus</i>	2	0	19	8
Arenaceous shale containing <i>Stropheodonta corrugata</i> and <i>Uncinulus stricklandi</i> in great abundance.....	0	8	17	8

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
<i>Keefer Sandstone Member</i>				
Heavy-bedded, gray sandstone with a few calcareous layers near bottom. The lower 5 feet of this sandstone contain <i>Stropheodonta corrugata</i> , <i>S. convexa</i> , <i>Leptæna rhomboidalis</i> , <i>Dalmanella elegantula</i> , <i>Camarotæchia neglecta</i> , <i>Atrypa reticularis</i> , <i>Spirifer niagarensis</i> , <i>Spirifer crispus</i> ?, <i>Cælospira sulcata</i> , <i>Hormatoma</i> sp., <i>Diaphorastoma niagarensis</i> , <i>Platyceras</i> sp., <i>Coleolus</i> sp., <i>Calymene niagarensis</i> , <i>Dalmanites limulurus</i> . The upper 5 feet contain <i>Cystid</i> sp., <i>Stropheodonta corrugata</i> , <i>Uncinulus stricklandi</i> , <i>Spirifer eudora</i>	17	0	17	0
Total thickness of Rochester formation described			37	10
<i>ROSE HILL FORMATION</i>				
Shale	1	8	40	7
Light-gray crystalline limestone and interbedded shale carrying <i>Stropheodonta corrugata</i> , <i>S. convexa</i> , <i>Leptæna rhomboidalis</i> , <i>Camarotæchia neglecta</i> , <i>Atrypa reticularis</i> , <i>Cælospira sulcata</i> , <i>Dalmanites limulurus</i> .	1	8	37	3
Light crystalline limestone carrying <i>Leptæna rhomboidalis</i> , <i>Chonetes novascoticus</i> , <i>Spirifer radiatus</i> , <i>Cælospira sulcata</i> , <i>Liocalymene clintoni</i>	1	1	35	7
Drab to olive shale with thin limestone bands near bottom carrying <i>Chonetes novascoticus</i> , <i>Dalmanella elegantula</i> , <i>Camarotæchia neglecta</i> , <i>Liocalymene clintoni</i> , and many crinoid stems.....	11	6	34	6
Reddish-colored, thin-bedded shale with two calcareous sandstone bands 3 and 7 feet respectively above the bottom with sandstone layers bearing <i>Chonetes novascoticus</i> , <i>Cælospira sulcata</i> , and <i>Tentaculites</i> sp.	23	0	23	0
Thickness of Rose Hill formation described....			40	7

The occurrence of *Dalmanites limulurus* in the upper beds of the Rose Hill formation is notable.¹

D. Sections in Cacapon Mountain Anticline

VIII. Section East of Great Cacapon, West Virginia

A good section of the Rochester formation and of portions of the overlying McKenzie and underlying Rose Hill formations is exposed on the

¹ See foot-note, page 200.

Baltimore and Ohio Railroad $1\frac{1}{2}$ miles east of Great Capapon. The beds are folded into a sharp syncline, the Keefer sandstone being finely exposed in its western limb.¹ The strata beneath the Keefer sandstone are unusually arenaceous at this locality and could fittingly be combined with the Keefer but contain the fauna of the upper Rose Hill of Cumberland. A very interesting feature of this section is the occurrence of *Dalmanites limulurus* 23 feet beneath the base of the Keefer sandstone, a feature which led Ulrich and Stose to refer these beds to the Rochester formation in their discussion of the area embraced in the Pawpaw-Hancock Folio of the U. S. Geological Survey. The section resembles, in this respect, that seen at Flintstone.

McKENZIE FORMATION	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Interbedded, dark-blue limestone and shale.....	20	0	..	..
Concealed. Thickness of this interval is unknown....	..	..	..	..
Dark-gray, rather fissile shale and interbedded, impure, lenticular, light-weathering limestone, more shale than limestone	11	0	48	9
Drab, fissile shale, breaking into large thin plates, intersected by joints, an occasional thin bed of impure limestone	6	2	37	9
Dark-colored limestone, conglomerate at top.....	0	9	31	7
Fissile, drab shale, a few thin impure limestone lenses near middle	2	3	30	10
Limestone conglomerate, pebbles flat $\frac{1}{2}$ to 2 inches thin dimension, usually parallel to bedding, weathered surfaces gray. Many ostracoda.....	0	7	28	7
Interbedded fissile gray shale and thin-bedded blue limestone	28	0	28	0
Thickness of McKenzie formation described....			48	9

ROCHESTER FORMATION

Bluish-gray limestone, highly fossiliferous with many calcite veins. The limestone weathers to a slightly greenish tone. This unit contains <i>Pholidops squamiformis</i> , <i>Stropheodonta corrugata</i> , <i>Reticularia bico-stata</i> , <i>Trematospira camura</i> , <i>Nucula</i> sp., <i>Dalmanites limulurus</i> , <i>Klædenia cacaponensis</i>	0	8	22	5
---	---	---	----	---

¹ This section was described by G. W. Stose, U. S. Geol. Survey, Pawpaw-Hancock Folio, No. 179, 1912, p. 4.

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Interbedded gray shale and bluish limestone. Seventeen inches above Keefer sandstone occur <i>Dizygo-pleura lacunosa</i> , <i>D. intermedia antecedens</i> , <i>D. intermedia cornuta</i>	1	1	21	9
Grayish-blue limestone with calcite veins, highly fossiliferous bearing <i>Pholidops squamiformis</i> , <i>Stropheodonta corrugata</i> , <i>Dalmanella elegantula</i> , <i>Rhipidomella</i> cf. <i>hybrida</i> , <i>Camarotoechia neglecta</i> , <i>Whitfieldella marylandica</i> , <i>Nucula</i> sp., <i>Tentaculites</i> sp., <i>Encrinurus ornatus</i> , <i>Dalmanites limulurus</i> , <i>Aechmina spinosa</i> , <i>Calymmene niagarensis</i>	0	6	20	8
Arenaceous shale	0	2	20	2

Keefer Sandstone Member

Massive sandstone above with interbedded shale and limestone below comprising the following beds:

Massive gray sandstone with pitted surfaces containing, a little distance below its center, <i>Stropheodonta corrugata</i> , <i>Dalmanella elegantula</i> , <i>Rhipidomella</i> cf. <i>hybrida</i> , <i>Camarotoechia neglecta</i> , <i>Spirifer</i> sp., <i>Pterinea</i> cf. <i>emacerata</i> , <i>Homalonotus delphinocephalus</i>	6	9	20	0
Shaly sandstone	0	7	13	3
Massive gray sandstone with pitted surfaces and <i>Scolithus keeferi</i>	12	8	12	8

Thickness of the Rochester formation.....			22	5
---	--	--	----	---

ROSE HILL FORMATION

Alternating thin beds of sandstone and dark-gray shale.	2	0	88	0
Thin alternating laminæ of sandstone and drab shale. A few thicker sandstone bands also occur. The shales are penetrated by openings $\frac{1}{8}$ inch in diameter filled with sand. These resemble worm borings. A fault occurs here	2	6	86	0
Interbedded sandstone and shale	1	0	83	6
Drab shale	0	6	82	6
Interbedded, bluish-gray limestone and shale. The limestone has inclusions of thin films of shale and is highly fossiliferous but fossils cannot be easily gotten out or determined. <i>Cælospira sulcata</i> observed	0	10	82	0
Drab shale, occasional thin sandstone bed near top containing <i>Chonetes</i> sp., <i>Cælospira sulcata</i>	12	6	81	2
Bluish-gray limestone with some thin shale partings containing <i>Cælospira sulcata</i>	0	6	68	8

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Sandstone bluish-gray	0	2	68	2
Bluish-gray sandstone, somewhat fossiliferous, passing on strike into more fossiliferous limestone. This unit contains <i>Rhipidomella hybrida</i> , <i>Camarotoechia</i> sp., <i>Atrypa reticularis</i> , <i>Caelospira sulcata</i> , trilobite fragments	0	6	68	0
Cross-bedded sandy shale and sandstone with a bed of limestone 1 foot thick in middle, containing <i>Beyrichia postulata</i> , <i>B. distincta</i> , <i>B. proutyi</i> , <i>B. consimilis</i>	2	6	67	6
Interbedded shale and crystalline gray fossiliferous limestone bearing <i>Cornulites</i> cf. <i>rosehillensis</i> . At top occur <i>Mastigobolbina typus</i> , <i>M. arguta</i> , <i>M. rotunda</i> , <i>M. trilobita</i> , <i>M. arctilimbata</i> , <i>Plethobolbina typicalis</i> , <i>Beyrichia lakemontensis</i> , <i>Bonnemaia celsa</i> , <i>Dizygopleura loculata</i> , <i>Stropheodonta corrugata</i> , <i>S.</i> cf. <i>convexa</i> , <i>Leptena rhomboidalis</i> , <i>Chonetes</i> sp., <i>Dalmanella elegantula</i> , <i>Rhipidomella</i> cf. <i>hybrida</i> , <i>Camarotoechia neglecta</i> , <i>Dalmanites limulurus</i> , <i>Diaphorotoma niagarensis</i> , <i>Liocalymmene clintoni</i>	4	6	65	0
Alternating, rather fissile olive to drab shale, thin calcareous sandstone and limestone. Some of the limestones are fossiliferous, <i>Chonetes novascoticus</i> occurring 11, 14, and 16 feet below top. Nineteen feet below top are many <i>Dalmanella elegantula</i> . <i>Zygoseella vallata</i> occurs 16 feet below top.....	36	6	60	6
Red ferruginous sandstone and interbedded shale ("iron ore") consisting of a massive ferruginous sandstone 2 feet 8 inches thick above, and olive to drab shale and thin ferruginous sandstone below...	10	0	24	0
Olive to drab, rather fissile shale with occasional sandstone layers	14	0	14	0
A fault occurs here of unknown throw, rendering the stratigraphic position of the underlying rocks insecure.				
Total thickness of the Rose Hill formation described			88	0

The large amount of sandstone in the upper part of the Rose Hill at this place is notable. Because of this fact Ulrich and Stose referred these beds to the Keefer sandstone in their discussion of this locality in the Pawpaw-Hancock folio of the U. S. Geological Survey and made the

Keefer sandstone McKenzie. The ostracod studies, however, led Ulrich and Bassler to consider these beds pre-Rochester which is in harmony with the work of the authors who showed that the Rochester fauna lies above the Keefer sandstone at Great Cacapon.¹

IX. Section East of Tonoloway

A section extending from the Bloomsburg red shale to the base of the upper beds of the Rose Hill formation is seen on the Western Maryland Railway about $1\frac{1}{2}$ miles east of Tonoloway. This locality is nearly opposite the exposure east of Great Cacapon described in the foregoing pages. This section, like the last one described, affords an excellent exposure of the Rochester formation.

WILLS CREEK FORMATION

Bloomsburg Member

Red sandstone and shales.

McKENZIE FORMATION	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Greenish arenaceous shale.....	5	0	229	11
Drab shale and thin bands of dark limestone.....	11	0	224	11
Drab, calcareous shale containing numerous ostracods.	4	0	213	11
Dark shale and thin bands of dark limestone largely concealed	77	0	209	11
Red arenaceous shale. The <i>McKenzie Red Bed</i>	5	0	132	11
Drab shale, arenaceous above with interbedded dark impure limestone which weathers with pitted surfaces. Some beds of limestone are very fossiliferous, containing numerous <i>Camarotochia andrewsi</i> 18 feet above its base, <i>Hormatoma</i> sp. 13 to 14 feet above its base, and many ostracods 7 feet above base.....	43	0	127	11
Dark, massive, calcareous shale with a band of dark impure limestone 5 inches thick at its base containing <i>Hormatoma</i> sp.....	9	5	84	11
Interbedded thin beds of lenticular, dark-blue limestone and drab shale containing numerous <i>Hormatoma</i> sp. Near center is a bed of limestone conglomerate 6 inches thick	5	6	75	6
Interbedded dark limestone and drab shale a little thicker-bedded than the above.....	8	0	70	0
Mostly concealed	11	0	62	0

¹ Ulrich formerly identified the Dalmanites in these beds as *D. limulurus*. He is now inclined to consider it distinct from the latter species.

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Arenaceous drab shale.....	1	6	51	0
Blue limestone containing <i>Hormatoma</i> sp., ostracods..	0	6	49	6
Impure dark-blue limestone.....	1	6	49	0
Hackly drab shale.....	1	6	47	6
Dark impure sandy limestone.....	1	0	46	0
Interbedded drab shale and thin-bedded dark-blue limestone. This unit bears <i>Camarotoechia andrewsi</i> , <i>Hormatospira evax</i> var. <i>marylandica</i> , <i>Spirifer</i> sp. large form, <i>Orthoceras</i> sp., <i>Beyrichia moodyi</i> , 4 feet beneath the top the rocks are crowded with <i>Euklædenella indivisa</i> , <i>E. umbilicata</i> , <i>E. primitioides</i> and many species of <i>Dizygopleura</i> , especially <i>D. stosei</i> ...	11	0	45	0
Limestone conglomerate layer at top, underlain by interbedded dark, impure limestone and drab shale containing, at base, <i>Beyrichia moodyi</i> and species of <i>Dizygopleura</i> especially <i>D. stosei</i>	6	6	34	0
Interbedded fissile drab shale and dark-blue, fine-grained impure lenticular limestone. Seven feet below top occur <i>Æchmina bimuralis</i> , <i>Euklædenella brevis</i> , <i>E. simplex</i> , <i>E. foveolata</i> , <i>E. bulbosa</i> , <i>E. similis</i> , <i>E. sulcifrons</i> , <i>E. sinuata proclivis</i> , <i>E. longula</i> , <i>Klædenella cacaponensis</i> , <i>K. scapha</i> , <i>Dizygopleura stosei</i> , <i>D. falcifera</i> , <i>Bythocypris pergracilis</i>	28	0	28	0
Approximate thickness of McKenzie formation..			229	11

ROCHESTER FORMATION

Dark-colored, fine-grained, impure limestone above, olive shale below, containing <i>Buthotrephis</i> sp., <i>Spirifer</i> sp., <i>Reticularia</i> cf. <i>bicostata</i> , <i>Trematospira</i> cf. <i>camura</i> , <i>Nucula</i> sp.....	0	4	26	7
Fissile, olive shale ¹	0	3	26	3
Dark, semicrystalline limestone in part a limestone conglomerate carrying <i>Favosites</i> sp., <i>Spirifer</i> sp., <i>Reticularia</i> cf. <i>bicostata</i> , <i>Trematospira camura</i> , <i>Nucula</i> sp., <i>Homalonotus delphinocephalus</i> , <i>Orthoceras</i> sp., <i>Calymene</i> sp., <i>Æchmina spinosa</i>	0	8	26	0
Olive, argillaceous shale.....	0	4	25	4
Bluish-gray, very fossiliferous limestone containing <i>Cornulites</i> sp., with marked longitudinal striations, <i>Spirifer</i> sp., <i>Reticularis bicostata</i> , <i>Trematospira camura</i> , <i>Whitfieldella marylandica</i> , <i>Hormatoma</i> sp.,				

¹ Ulrich and Bassler made this unit the base of the McKenzie formation.

	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
<i>Drepanellina clarki</i> , <i>Dizygopleura symmetrica</i> , <i>Æchmina abnormis</i>	0	4	25	0
Bluish-gray crystalline limestone carrying <i>Buthotrephis</i> sp., <i>Pholidops squamiformis</i> , <i>Stropheodonta corrugata</i> , <i>Schuchertella</i> sp., <i>Camarotæchia neglecta</i> , <i>Dalmanella elegantula</i> , <i>Reticularia bicostata</i> , <i>Trematospira</i> cf. <i>camura</i> , <i>Clidophorus nitidus</i> , <i>Orthoceras</i> sp., <i>Encrinurus ornatus</i> , <i>Calymmene niagarensis</i> , <i>Dalmanites limulurus</i> , <i>Æchmina abnormis</i> , <i>Drepanellina clarki</i>	0	4	24	3
Olive to drab arenaceous shale bearing <i>Drepanellina clarki</i> , <i>Dizygopleura symmetrica</i> , <i>Æchmina abnormis</i> , <i>A. spinosa</i> , <i>Beyrichia veronica</i>	0	4	23	11
Bluish-gray limestone containing <i>Pholidops</i> cf. <i>squamiformis</i> , <i>Stropheodonta corrugata</i> , <i>Schuchertella elegans</i> , <i>Dalmanella elegantula</i> , <i>Camarotæchia neglecta</i> , <i>Atrypa reticularis</i> , <i>Whitfieldella marylandica</i> , <i>Clidophorus nitidus</i> , <i>Hormatoma</i> sp., <i>Coleolus</i> sp., <i>Tentaculites niagarensis</i> var. <i>cumberlandie</i> , <i>Cornularia niagarensis</i> , <i>Dizygopleura symmetrica</i> , <i>Laccoprinitia resseri</i> , <i>Aparchites alleghaniensis</i> , <i>Drepanellina clarki</i> , <i>Æchmina abnormis</i> , <i>A. spinosa</i> , <i>Beyrichia veronica</i>	0	6	23	7
Olive to drab shale and very thin sandstone lenses carrying <i>Pholidops squamiformis</i> , <i>Stropheodonta corrugata</i> , <i>Dalmanella elegantula</i> , <i>Camarotæchia neglecta</i> , <i>Clidophorus nitidus</i> , <i>Tentaculites</i> cf. <i>niagarensis</i> , <i>Calymene</i> cf. <i>niagarensis</i> , <i>Homalonotus delphinocephalus</i> , <i>Dalmanites limulurus</i> , <i>Drepanellina clarki</i> , <i>D. simplex</i> , <i>Dizygopleura symmetrica</i> , <i>Æchmina spinosa</i> , <i>A. abnormis</i> , <i>A. postica</i> , <i>Beyrichia veronica</i>	0	8	23	1
Friable red sandstone, calcareous before weathering. This may represent the <i>Roberts iron ore</i> of the western sections	0	5	22	5

Keefer Sandstone Member

Massive sandstone, calcareous at some places. A band of shale occurs 2 feet below top. About 7 feet above base occur <i>Pholidops squamiformis</i> , <i>Reticularia bicostata</i> , <i>Trematospira camura</i> , <i>Nucula</i> sp., <i>Drepanellina clarki</i> , <i>Dizygopleura symmetrica</i> , <i>Æchmina abnormis</i> , <i>A. spinosa</i>	22	0	22	0
Total thickness of Rochester formation			26	7

ROSE HILL FORMATION	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Interbedded shale and sandstone.....	18	0	18	0
Concealed.				
Total thickness of Rose Hill formation exposed.			18	0

X. Section at Sir Johns Run

The best exposure of the Rose Hill formation in the vicinity of Hancock is seen one-half to three-fourths of a mile west of Sir Johns Station, on the Baltimore and Ohio Railroad. The Tuscarora formation is well exposed west of the station. A cut extends westward almost a quarter of a mile from the Tuscarora-Rose Hill contact, terminating at the Keefer sandstone member of the Rochester formation. This section is of special interest because it shows that the Rose Hill formation contains a larger number of ferruginous sandstones ("iron ores") in this area than in the western section.

The strata are folded and faulted so that the total computed thicknesses are not altogether reliable.¹

ROCHESTER FORMATION

Keefer Sandstone Member

Massive sandstone.

ROSE HILL FORMATION Traverse N. 56° E.	Horizontal distance to bottom of beds Feet	Thickness	
		Beds Feet	Total Feet
Shale with some beds of calcareous sandstone. N. 30° E. 67° W. It is possible that a fault occurs in this unit. Fifteen feet below the top occur <i>Cælospira</i> <i>sulcata</i> , <i>Dalmanella elegantula</i>	150.0	61.0	437.7
Ferruginous sandstone varying somewhat in thickness. N. 16° E. 65° E.....	152.0	1.2	376.7
Olive to drab shale with thin bands of sandstone. Pos- sible faulting	437.0	123.5	375.5
Ferruginous sandstone	441.0	1.5	252.0

¹ The horizontal traverse begins at the base of the Keefer sandstone and extends eastward. The measurements were made by tape along the line of telegraph poles.

	Horizontal distance to bottom of beds Feet	Thickness	
		Beds Feet	Total Feet
Section repeated by minor folding. The ferruginous sandstone bed at 441 feet is seen in the axis of a minor syncline at 575 feet ¹	575.0	..	..
Olive to drab shale and some thin bands of sandstone. About 40 feet below the top of this unit occur <i>Tentaculites minutus</i> , <i>Liocalymene clintoni</i> , <i>Calymene crespensis</i>	806.0	76.0	250.5
Traverse N. 54° E.			
Olive to drab shale and thin sandstone beds. N. 30.9° E. 52° W.....	967.0	51.0	174.5
Traverse N. 51° E.			
Olive to drab shale and thin beds of sandstone. N. 28° E. 46° W.	1081.5	31.0	123.5
Ferruginous sandstone	1087.5	2.5	91.5
Traverse N. 51.5° E.			
Olive to drab shale, thin beds of sandstone, N. 28° E. 46° W.	1235.0	42.0	89.0
Olive to drab shale and thin beds of sandstone. N. 36.4° E. 48.6° W.	1508.0	47.0	47.0
Approximate thickness of Rose Hill formation.			437.7

TUSCARORA FORMATION

Massive sandstone.

XI. Section at Grasshopper Run

A section exposing the upper strata of the McKenzie formation and the Keefer sandstone member of the Rochester formation is seen on the Baltimore and Ohio Railroad near the mouth of Grasshopper Run, 2 miles southwest of Hancock. The upper beds of the McKenzie are finely exposed on the hillside a short distance south of the railroad track, beneath the heavy outcropping ledges of the Bloomsburg red sandstone, which forms the top of a small knob east of the run. The Keefer sandstone member of

¹ Strike and dip are as follows: 441 to 538 feet horizontally, N. 30° E. 70° W.; 538 to 670 feet horizontally N. 29° E. 54° W.; 670 to 806 feet horizontally N. 32° E. 59° W.

the Rochester formation and the immediately underlying beds are well exposed south of the railroad track on the west side of the ravine.

This locality affords an excellent collecting ground for the fossils found in the strata between the Bloomsburg and McKenzie red beds.

WILLS CREEK FORMATION

Bloomsburg Member

Red sandstone and shale.

	Thickness	
	Beds Feet	Total Feet
McKENZIE FORMATION		
Argillaceous greenish-gray sandstone and some interbedded greenish-gray shale	4	244
Drab to olive fissile shale with numerous thin beds of dark to bluish-gray crystalline limestone and calcareous sandstone. Fossils occur in great profusion in the limestone beds at the following distances in feet above the base of this unit: <i>Orthoceras</i> sp., 79; <i>Lingula</i> sp., <i>Clidophorus nitidus</i> , <i>Orthoceras</i> sp., ostracods, 73; <i>Lingula</i> sp., <i>Orthoceras</i> sp., ostracods, 71; ostracods, 62; <i>Homæospira evax</i> var. <i>marylandica</i> , <i>Orthoceras</i> sp., 56; <i>Dalmanella</i> cf. <i>elegantula</i> , <i>Leptæna rhomboidalis</i> , <i>Camarotæchia andrewsi</i> , cf. <i>Homæospira evax</i> var. <i>marylandica</i> , 54; <i>Dalmanella elegantula</i> , <i>Camarotæchia andrewsi</i> , <i>Uncinulus obtusipliatus</i> , <i>Spirifer mackenzicus</i> , <i>Orthoceras</i> sp., <i>Calymene niagarensis</i> var. <i>restrictus</i> , <i>Cordyocephalus ptyonurus</i> , 52; <i>Spirifer mackenzicus</i> abundant, 47-48; <i>Lingula</i> sp., 39, 33; <i>Pterinea flintstonensis</i> , <i>Schuchertella</i> sp., <i>Beyrichia moodyi</i> , 21; <i>Camarotæchia andrewsi</i> , 50-46, 39, 33, 26, 14, 10.....	83	240
Red, sandy shale. <i>McKenzie red beds</i>	5	157
Olive, very fissile shale, becoming mottled on weathering. Dark, impure limestone at base.....	30	152
Concealed in large part. Shale and limestone bands.....	32	122
Concealed in valley.....	90	90
	—	—
Approximate thickness of McKenzie formation.....		244

ROCHESTER FORMATION

Concealed.

Keefer Sandstone Member

Massive sandstone, its base marked by a distinct unconformity..	25	25
Thickness of Keefer sandstone member.....		25

ROSE HILL FORMATION	Thickness			
	Beds		Total	
	Feet	Inches	Feet	Inches
Hard, dark shale	5	0	36	4
Massive sandstone	7	6	31	4
Interbedded shale and sandstone.....	3	0	23	10
Fissile, olive to drab shale.....	15	6	20	10
Calcareous sandstone containing <i>Dalmanella eleganta</i> , <i>Calospira sulcata</i> , ostracods.....	0	4	5	4
Drab shale with thin bands of limestone. A thin band of sandstone 3 feet below top. This unit contains <i>Spirifer eudora</i> , <i>Calospira sulcata</i> abundant, ostracods	5	0	5	0
Concealed.				
Total thickness of Rose Hill formation described			36	4

E. Sections in Keefer Mountain Anticline

XII. Section West of Keefer Mountain

This section is exposed in the bed and on the north bank of a small run which rises in a ravine between Dickeys and Keefer mountains and flows due west, entering Licking Creek at a point 1 mile in an air line north of the Pennsylvania-Maryland state line. The section begins approximately 1800 feet east of the mouth of the stream and extends toward the east. The locality is situated in Franklin County, Pennsylvania, about 6 miles northeast of Hancock.

WILLS CREEK FORMATION	Thickness	
	Beds	Total
	Feet	Feet
<i>Bloomsburg Member</i>		
Red sandstone and shale. Thickness about.....	78	78
McKENZIE FORMATION		
Concealed, probably shale.....	17	224
Red, sandy shale.....	1	207
Concealed, probably largely shale.....	74	206
Red, sandy shale. <i>McKenzie red beds</i>	24	132
Mostly concealed, occasional exposure of drab shale.....	108	108
Total thickness of the McKenzie formation.....		224

	Thickness	
	Beds Feet	Total Feet
ROCHESTER FORMATION		
<i>Keefer Sandstone Member</i>		
Massive sandstone. This sandstone is finely exhibited on the crest of the knob through which the Franklin-Fulton county boundary line passes and which lies north of the run.....	25	25
Total thickness of the Rochester formation exposed.....		25

ROSE HILL FORMATION		
Largely concealed. Portions of this unit exposed nearby show it to consist chiefly of shale with thin interbedded sandstones and arenaceous limestones. From 5 to 20 feet below the Keefer sandstone occur <i>Chonetes novascoticus</i> , <i>Camarotæchia neglecta</i> , <i>Cælospira hemispherica</i> , <i>Tentaculites minutus</i> , <i>Liocalymmene clintoni</i> , <i>Dizygopleura symmetrica</i>		
	93	413
Red ferruginous sandstone.....	50	320
Largely concealed. This unit probably consists chiefly of shale with thin interbedded beds of sandstone. The following fossils were collected from the lower part of the unit on the east slope of the hill mentioned above: <i>Chonetes novascoticus</i> , <i>Camarotæchia neglecta</i> large form, <i>Tentaculites minutus</i> , <i>Liocalymmene clintoni</i> , <i>Calymene cresapensis</i> abundant.....		
	90	270
Olive shale with a few thin bands of sandstone.....	180	180
Concealed.		
Total thickness of Rose Hill formation exposed.....		413

F. Sections in Fairview Mountain Anticline

The Fairview Mountain anticline is attended by several subordinate anticlines in Maryland. Two of these, the Cross Mountain and the Hearthstone Mountain anticlines, are west of Fairview Mountain, while the Powell-Johnson Mountain anticline lies east. The first of the following sections is in the Cross Mountain anticline, the second in the Fairview Mountain anticline, and the third in the Powell-Johnson Mountain anticline.

XIII. Section on Rabble Run¹

WILLS CREEK FORMATION

Bloomsburg Member

Red shale and sandstone seen on road east of bridge.

¹ This section was measured with tape by C. K. Swartz assisted by G. Taylor.

McKENZIE FORMATION	Horizontal distance from beginning of traverse to base of beds Feet	Thickness	
		Beds Feet	Total Feet
The section is measured along the county road, the traverse beginning 450 feet east of the center of bridge. Strike and dip in this part of the section N. 54° E. 24° E., average of three observations.....			
Traverse due west			
Fissile shale. A bed of fossiliferous, crystalline, blue limestone at base, contains <i>Camarotæchia andrewsi</i> abundant, and <i>Orthoceras mackenzicus</i>	97.0	31.0	265.1
Fissile shale, a bed of crystalline blue limestone at base contains <i>Camarotæchia andrewsi</i> , <i>Klædenella nitida</i> , <i>Dizygopleura halli</i> , <i>D. intermedia</i> , <i>D. perrugosa</i> and <i>Beyrichia moodyi</i>	115.0	5.5	234.1
Fissile shale. A band of blue limestone at base contains <i>Camarotæchia andrewsi</i>	122.0	2.5	238.6
Fissile shale. A band of blue limestone at base contains <i>Camarotæchia andrewsi</i>	134.0	4.0	226.1
Fissile shale. A band of blue limestone at base contains <i>Camarotæchia andrewsi</i>	159.0	8.0	222.1
Fissile shale. A band of blue limestone at base contains <i>Camarotæchia andrewsi</i>	184.0	8.5	214.1
Red shale	185.0	0.7	205.6
The section is continued in the cliff immediately south of the bridge where the thin band of red shale last described is visible 8 feet below the top of the cliff.			
At top of the cliff 9 feet above the red band there occur in the soil <i>Camarotæchia andrewsi</i> abundant, <i>Spirifer mackenzicus</i> , <i>Klædenella nitida</i> , <i>Dizygopleura halli</i> , <i>D. intermedia</i> , <i>D. perrugosa</i> and <i>Beyrichia moodyi</i>			
Interbedded fissile gray shale and numerous bands of blue limestone containing <i>Spirifer mackenzicus</i> abundant, <i>Camarotæchia andrewsi</i> very abundant 6 to 7 feet above base of unit. <i>Pterinea flintstonensis</i> 5 to 6 feet above base.....	7.0		212.6
Red shale. This is the same band as the one exposed at 185 feet horizontally upon the county road.....	0.7		205.6
Interbedded fissile gray shale and highly fossiliferous blue crystalline limestone. The limestone contains <i>Camarotæchia andrewsi</i> in great profusion in nearly every foot of the beds. Additional fossils are found above the base of this unit as follows: <i>Homæospira evax</i> var. <i>marylandica</i> , 10; <i>Clidophorus nitidus</i> , 2-3; <i>Pterinea flintstonensis</i> , 3, 10-14, abundant; <i>Klædenella nitida</i> , <i>Dizygopleura halli</i> , <i>D. intermedia</i> , <i>D. perrugosa</i> and <i>Beyrichia moodyi</i> , near base and top of unit.....	35.5		204.9

	Thickness	
	Beds Feet	Total Feet
The section is continued in a dry run a short distance west of the bridge.		
Red arenaceous shale, upper surface discolored.....	0.4	169.4
Red argillaceous sandstone.....	1.2	169.0
Red shale	0.4	167.8
Red and greenish sandstone, discolored in part.....	3.0	167.4
Fissile green shale	1.2	164.4
Greenish sandstone	1.0	163.2
Red, arenaceous sandstone	11.0	162.2
The section is continued in the bluff which forms the north bank of Rabble Run where the red sandstone seen at the top of the section in the dry run outcrops in the top of the bluff 200 feet northeast of the bridge.		
Interbedded red shale and sandstone. This unit is 32 feet thick and includes at its top the beds exposed in the dry run.....		
Massive, argillaceous sandstone.....	13.8	151.2
Red, arenaceous shale and some interbedded sandstone.....	2.0	137.4
Massive red sandstone forming a prominent ledge at the bottom of the cliff, 250 feet northeast of the road.....	13.0	135.4
	8.0	122.4
The section is continued in the cliff 500 feet northeast of the road where the massive red sandstone last described forms a conspicuous projecting ledge in the cliff on the south side of the run. N. 81° E. 12° W.		
Red shale	0.3	114.4
Gray shale	4.0	114.1
Red shale	1.0	110.1
Fissile gray shale.....	4.5	109.1
Red shale	0.5	104.6
The section is continued on the north side of the run 575 feet northeast of the road.		
Red sandstone	1.1	104.1
Red shale	3.0	103.0
Fissile gray shale above. Concealed below to base of formation approximately	100.0	100.0
Approximate thickness of McKenzie formation.....		265.0
A notable feature of this section is the great development of Red beds in the McKenzie.		

XIV. Section on Lanes Run

This section is situated on Lanes Run, 3 miles in an air line northwest of Clear Spring, Maryland, and 1 mile southwest of Stone Cabin Gap. It is $1\frac{1}{2}$ miles southeast of the preceding section. The lower part of the

McKenzie formation is exposed in the bed of Lanes Run. The massive ledges of the Keefer sandstone outcrop in the east bank of the run 0.45 mile in an air line northeast of the junction of Stone Cabin and Rabble Run roads. The section begins at the point where the top of the sandstone crosses the stream N. 24° W. from the top of this ledge, and continues thence up the bed of the run. The latter locality may be found by following the top of the Keefer sandstone from its exposure in the east bank of the run to its outcrop in the field a short distance towards the south-east. A traverse was run from this point at right angles to the strike of the strata across the outcrop of the McKenzie and Wills Creek formations.

This locality affords the most trustworthy measurements of the lower part of the McKenzie formation obtained in the North Mountain region. The measurements of the upper part of the formation are less precise owing to the difficulty in securing accurate strikes and dips.¹

Section exposed on hill southeast of Lanes Run and northwest of cemetery. Strike and dip used in calculating this part of the section N. 23° E. 40° E., the average of 10 observations.

WILLS CREEK FORMATION		Horizontal distance to top of unit Feet	Thickness	
<i>Bloomsburg Member</i>			Beds Feet	Total Feet
Red argillaceous sandstone and arenaceous shale exposed on hilltop.				
McKENZIE FORMATION				
Fissile, yellowish shale. The top of this unit is 10 feet vertically above base of the McKenzie.....	492	66	250	
Red arenaceous shale.....	397	12	184	
Red, shaly sandstone, making an indistinct ridge on the top of the knob.....	387	1	172	
Red, arenaceous shale. The top of the Keefer sandstone outcrops in the field 358 feet N. 63° W. from the base of this bed.....	397	83	171	
The section is continued by following the base of the red beds of the McKenzie from its outcrop in the east bank of Lanes Run to its outcrop in the field southwest of exposure in bank. This part of the traverse is neglected in horizontal measurements given.				

¹ Measured by tape by C. K. Swartz assisted by G. Taylor.

Traverse N. 75° E. down center of stream ¹

	Horizontal distance to top of unit Feet	Thickness	
		Beds Feet	Total Feet
Concealed	254	14	88
Dark-gray shale outcropping in ridges crossing stream....	226	36	74
Largely concealed, some beds of dark-gray shale seen in bed of stream	150	33	38
Fissile gray shale exposed in bed of stream.....	105	5	5
Total thickness of McKenzie formation.....			200

ROCHESTER FORMATION

Keefer Sandstone Member

Massive conglomeratic sandstone seen on the east bank of
the stream S. 24° W. from the base of the preceding unit.

This section like the preceding is remarkable for the great thickness of red beds in the McKenzie, leading Stose to map much of this formation as the Bloomsburg red sandstone in the Pawpaw-Hancock folio of the U. S. Geological Survey.

XV. Section at Hanging Rock

The name Hanging Rock is applied to the massive ledges of the Tuscarora formation exposed in Stone Cabin Gap, at the southern extremity of Sword Mountain, 2½ miles in an air line northwest of Clear Spring. The best exposure of the Rose Hill formation in the North Mountain of Maryland is seen here, affording an almost uninterrupted section of that formation. The thickness of the Rose Hill is much less at this place than it is farther west. There is no satisfactory evidence of faulting and it may be that the reduction in thickness is due to thinning eastward.

The horizontal traverse begins at the base of the Keefer sandstone and extends southeastward along the county road to the top of the Tuscarora sandstone.²

¹ Strike and dip employed in calculating the thickness of beds beneath the McKenzie red bed N. 23° E. 40° E., the average of 10 observations.

² Measured with tape by C. K. Swartz assisted by G. Taylor. Strike and dip of beds N. 18° E. 61° E., average of 8 observations.

ROCHESTER FORMATION <i>Keefer Sandstone Member</i> Traverse S. 45° E.	Horizontal distance from begin- ning of traverse to top of beds Feet	Thickness	
		Beds Feet	Total Feet
Massive conglomeratic sandstone.....	..	25.0	25.0
ROSE HILL FORMATION			
Concealed. Fissile shale in soil. At the top of this unit were found in loose fragments of sandstone <i>Cælospira sulcata</i> , <i>Liocalymmene clintoni</i> abundant <i>Calymene niagarensis</i> var.....	64.5	48.0	300.5
Ferruginous sandstone loose in soil.....	65.0	1.0	252.5
Concealed	69.4	3.0	251.5
Hard, gray sandstone rather thin-bedded, stained brown	75.7	4.6	248.5
Concealed. Soil contains fissile gray shale covered with sandstone drift.....	85.0	7.0	243.9
Bluish ferruginous sandstone.....	87.7	2.0	236.9
Concealed	99.0	8.8	234.9
Fissile gray shale.....	100.0	0.8	226.1
Four heavy ledges of blue ferruginous sandstone with interbedded fissile, gray shale in lower part.....	125.7	20.0	225.3
Fissile, gray, argillaceous shale, a very little, thin-bedded, very argillaceous sandstone. Almost entire unit weathered into soil.....	184.0	45.4	205.3
Thin-bedded, very argillaceous sandstone.....	185.0	0.8	159.9
Fissile, gray shale well exposed. Ten feet above bottom of this unit (202 feet horizontally) occur crinoid stems and a few <i>Cælospira hemispherica</i> , <i>Calymene</i> cf. <i>blumenbachii</i> var. <i>macrocephala</i> , <i>Liocalymmene clintoni</i> , <i>Bonnemaia perlonga</i>	214.0	22.6	159.1
Fissile, gray shale, interbedded with heavier shales and lenticular argillaceous sandstone, breaking irregularly	221.0	5.5	136.5
Interbedded, thin-bedded, hard, argillaceous sandstone and arenaceous shale. A sandstone band 6 inches thick occurs at top of unit.....	224.0	2.3	131.0
Greenish-gray, arenaceous shale, breaking irregularly.	226.0	1.6	128.7
Fissile shale reddish tone.....	232.0	4.7	127.1
Fissile, gray shale and a very little thin-bedded argillaceous sandstone; 12.5 feet above base of this unit (248 feet horizontally) crinoid stems and <i>Calymene</i> sp. occur.....	264.0	24.9	122.4
Hard, thin-bedded, greenish-gray sandstone with a little interbedded arenaceous shale.....	269.0	3.9	97.5
Concealed. Soil contains gray sandstone fragments..	284.0	11.7	93.6
Interbedded, fissile gray shale and some thin-bedded argillaceous sandstone	323.5	30.7	81.9
Concealed	339.0	12.0	51.2

	Horizontal distance from beginning of traverse to top of beds Feet	Thickness	
		Beds Feet	Total Feet
Hard, greenish-gray sandstone, becoming thinner-bedded at base.....	392.0	6.2	39.2
Fissile, gray shale; some thicker and more arenaceous beds	502.0	33.0	33.0
Total thickness of the Rose Hill formation....			300.5

TUSCARORA FORMATION

Very massive, hard, white sandstone ("Hanging Rock").

XVI. Section One Mile Northwest of Clear Spring

This section is exposed on the north side of a millpond situated in the gap south of Johnson Mountain, 1 mile northwest of Clear Spring. The traverse begins at the first exposure of the red strata of the McKenzie formation and extends eastward along the north side of the millpond, to the top of the Tuscarora formation.

The section is thinner than is normal, due probably to faulting. Much of the lower part of the McKenzie has probably been concealed in this manner. Careful search was made for fossils but the strata appear to be barren, contrasting greatly, in this respect, with the richly fossiliferous beds of the Rose Hill formation farther west.¹

McKENZIE FORMATION	Horizontal distance from beginning of traverse to base of beds Feet	Thickness	
		Beds Feet	Total Feet
Concealed, red soil on slope.			
Red, very arenaceous shale and argillaceous sandstone, partially covered with soil.....	27.0	19.6	48.1
Two 4-inch courses of hard, reddish sandstone weathering greenish-gray	27.9	0.6	28.5
Red, argillaceous sandstone, breaking irregularly....	29.0	0.8	27.9
Greenish-gray, argillaceous sandstone, hard.....	30.4	1.0	27.1
Red, very arenaceous shale, partly concealed.....	35.0	3.3	26.1
Concealed	54.0	13.8	22.8
Argillaceous sandstone, greenish, micaceous in courses 2 to 8 inches thick.....	57.2	2.3	9.0
Concealed	66.5	6.7	6.7
Total thickness of the McKenzie formation exposed.			48.2

¹ Measured with tape by C. K. Swartz and G. Taylor.

ROCHESTER FORMATION <i>Keefer Sandstone Member</i>	Horizontal distance from begin- ning of traverse to base of beds Feet	Thickness	
		Beds Feet	Total Feet
Massive gray sandstone exposed on hillside.....	68.0	1.1	39.9
Concealed. Soil covered with gray sandstone drift....	81.0	9.4	38.8
Massive gray sandstone, stained mottled pink and light brown on surface. Beds 6 inches to 2 feet 6 inches thick	94.2	9.6	29.4
Massive, greenish-gray sandstone partly concealed in upper part, somewhat ferruginous at base. Surface stained brown, lower bed outcrops about 15 feet above on hillside.....	121.3	19.8	19.8
Thickness of Keefer sandstone.....			39.9

ROSE HILL FORMATION

Concealed. Fissile gray shale in soil.....	128.5	6.6	152.6
Dark-brown, ferruginous sandstone	130.5	1.9	146.0
Concealed. Soil containing fissile gray shale.....	140.5	9.2	144.1
Hard, greenish, argillaceous sandstone.....	141.3	0.7	134.9
Fissile, slightly gray arenaceous shale.....	142.6	1.2	134.2
Hard, greenish, argillaceous sandstone.....	142.8	0.2	133.0
Fissile gray shale and some interbedded thin-bedded argillaceous sandstone	147.8	4.6	132.8
Dark-red, arenaceous shale, weathers grayish, breaks irregularly	151.3	3.2	128.2
Fissile, gray arenaceous shale with some thin bands of argillaceous sandstone at base.....	156.5	4.8	125.0
Single course of brown ferruginous sandstone, surface stained by rust.....	157.1	0.6	120.2
Fissile, gray, arenaceous shale, breaks irregularly; weathers to yellows and browns.....	165.1	7.4	119.6
Hard, greenish-gray, argillaceous sandstone in two courses	166.8	1.6	112.2
Red, ferruginous shales, break irregularly.....	168.0	1.1	110.6
Interbedded, fissile gray shale and thin-bedded, greenish-gray argillaceous sandstone.....	171.0	2.8	109.5
Much weathered, greenish-gray, argillaceous sand- stone, medium-bedded	172.0	0.9	106.7
Interbedded, greenish-gray, fissile arenaceous shales and thin-bedded, argillaceous sandstone.....	179.0	6.5	105.8
Argillaceous sandstone in courses 1 to 4 inches thick, stained brown. Some surfaces marked by trails or fucoids. Base of unit forms projecting ledge:.....	181.5	2.3	99.3
Greenish-gray, arenaceous shale, weathering brown, surface of beds covered with trails or fucoid mark- ings	186.5	4.6	97.0

	Horizontal distance from begin- ning of traverse to base of beds Feet	Thickness	
		Beds Feet	Total Feet
Very thin-bedded, argillaceous sandstone exposed about 15 feet above on bank.....	190.5	3.6	92.4
Fissile, gray arenaceous shale breaking into small thin plates	193.5	2.8	88.8
Greenish-gray, arenaceous shale and argillaceous sand- stone, breaks irregularly.....	202.0	7.8	86.0
Interbedded, argillaceous sandstone and a little arena- ceous shale, sandstone bands $\frac{1}{2}$ to 2 inches thick, surface marked by trails or fucoids.....	205.2	3.0	78.2
Largely concealed. Some thick-bedded, arenaceous shale	211.0	5.4	75.2
Arenaceous shale, greenish-gray, marked by trails or fucoids	212.5	1.3	69.8
Interbedded, thin-bedded, argillaceous sandstone and arenaceous shale, greenish-gray, weathering brown; sandstone stained brown.....	218.0	5.1	68.5
Interbedded, argillaceous sandstone and arenaceous shale. Sandstone heavier-bedded and shale more fissile than in overlying unit. Heavier beds of sandstone at 221, 229 feet. A soft band at 232 feet, and a hard band at 233 feet forming base of unit...	233.8	14.6	63.4
Medium-bedded, arenaceous shale, breaking irregularly	239.8	5.5	48.8
Very argillaceous sandstone, stained brown.....	241.8	1.8	43.3
Concealed	244.8	2.8	41.5
Massive sandstone above arenaceous shale below. Up- per sandstone forms a projecting ledge.....	248.4	2.5	38.7
Massive sandstone	252.0	4.1	36.2
Thin-bedded, argillaceous sandstone and a little arena- ceous greenish-gray shale weathering mottled green and brown	254.2	2.0	32.1
Hard sandstone, stained brown.....	254.9	0.6	30.1
Fissile, gray shale becoming heavier-bedded at base..	262.2	6.7	29.5
Concealed	275.0	11.8	22.8
Soft, very argillaceous sandstone, gray, surface stained brown	276.0	0.9	11.0
Concealed	287.0	10.1	10.1
Total thickness of Rose Hill formation.....			152.7

TUSCARORA FORMATION

Massive sandstone seen a short distance above on
hillside and more clearly on opposite side of mill-
pond.

VITA

William Frederick Prouty was born in Putney, Windham County, Vermont, August 15, 1879. His early education was received in the Public Schools at Putney, Vermont, and in the Black River Academy at Ludlow, Vermont. He entered Syracuse University in the fall of 1899 and was graduated from that institution in the spring of 1903 with the degree of B. S. The following year he acted as Instructor in the department of geology in Syracuse University. During this year he also took courses and completed a thesis upon the "Manlius Formation of Onondaga County, New York," which he presented for the degree of M. S. in the spring of 1904.

During the two years 1905-1907 he pursued the prescribed courses of study in geology in The Johns Hopkins University under Professors Clark, Reid, Mathews, and Swartz. Also several special courses in various branches of geology given by prominent men from different universities together with a course in physical chemistry under Professor H. C. Jones.

The summers of 1904 and 1905 were spent in geological field work under the supervision of the Maryland Geological Survey. The work of the summer of 1904 was in the Piedmont and Coastal Plain regions; that of 1905 was in the Paleozoic formations of western Maryland.

He held a University Fellowship in Geology.

